

Floodscape Urbanism

Architectural Design Strategies for  
Manila at Risk

Paolo Zaide



## Copyright Statement

This text represents the submission for the degree of Doctor of Philosophy at the Royal College of Art. This copy has been supplied for the purpose of research for private study, on the understanding that it is copyright material, and that no quotation from the thesis may be published without proper acknowledgment.

## Abstract

This thesis develops design-led flood adaptation strategies for the city of Manila. With much ground already covered on cross-disciplinary approaches in flood risk management, this thesis considers the discussion of flood adaptation through the lens of ecological urbanism and architectural design. The issue is the fluid edge between city and water and is captured in the term 'floodscape', to give definition to a cityscape affected by fluctuating water levels. The thesis argues for the importance of urban design as the key driver to integrate the environmental and social concerns of the city in a holistic and critical way. Floodscape Urbanism therefore can be understood as a potential bridge between urbanism and hydrological cycles, with design providing a crucial framework within which to think about and act on environmental, technical, economic and socio-cultural challenges. Manila, as an extreme case of a flood-prone city, presents the challenge of having to balance vital flood management with creating places suitable for urban life that many cities in the global south are facing or will face.

The focus of the design research is the exploration of how holistic flood adaptation approaches can be applied and translated to the particular context of Manila, both as a strategic design process on a master plan level and as architectural design propositions at a neighbourhood scale. The written thesis establishes the theoretical framework for design-led flood adaptation and in the main chapters reflects on design from the scale of the city to the neighbourhood, and on the possibilities and limitations of architectural intervention. If architecture is to engage with the dilemma of cities at flood risk, the starting point is for architects to view flood adaptation not as a solution, but as an essential restructuring of assumptions in the way we live in flood zones, and the conditions that are necessary to support that life.

## Table of Contents

<b>Floodscape Urbanism: Manila at Risk</b>	<b>3</b>
<b>List of Figures</b>	<b>6</b>
<b>List of Illustrations</b>	<b>8</b>
<b>Acknowledgements</b>	<b>10</b>
<b>Introduction</b>	<b>13</b>
 <b>Part 1</b>	
<b>Chapter 1: Towards ecological practice</b>	<b>23</b>
1.1 Conventional to adaptive flood design	24
1.2 Flood-adaptive city models	31
1.3 Ecological urbanism and flood resilience	35
<b>Chapter 2: Manila's Water Narratives</b>	<b>43</b>
2.1 Three city layers	43
2.1.1 The Colonial City	45
2.1.2 The Modernist City	47
2.1.3 The Global City	49
2.2 Urban challenges and opportunities for design	50
<b>Chapter 3: Framing Design as Research</b>	
3.1 Year 1: Research 'into' (existing) design and analysis	61
3.1.1 Comparative study of four cities	61
3.1.2 Analysis of design practices	62
3.2 Year 2: Research 'through' design and interpretation	65
3.2.1 Defining test sites	65
3.2.2 Drawings as tools for analysis, interpretation and reflection	67
3.3 Year 3: Research 'for' design and application	69

## Part 2

<b>Chapter 4: Case Study Cities</b>	<b>75</b>
4.1 Case Study 1: Dhaka	77
4.2 Case study 2: New Orleans	83
4.3 Case Study 3: Hamburg	89
4.4 Developing Transferable Design Strategies	94
<b>Chapter 5: Strategies and Tactics for Design</b>	<b>103</b>
5.1 Insights into Manila's Ground	104
Testing and Mapping Manila's historic, post-industrial and informal ground	106
5.2 Design Strategies	109
5.2.1 Strategy 1: Environmental Framework – and 'Making Space for Water'	109
5.2.2 Strategy 2: Urban Framework – and 'Tactical Interventions'	112
5.2.3 Strategy 3: Temporal Framework – and 'Flexible Master Plans'	113
5.3 Tactical Designs	113
5.3.1 Tactical Approaches	113
5.3.2 Spatial Components	115
5.3.3 Plotting Interventions	117
<b>Chapter 6: Interventions and Illustrations</b>	<b>131</b>
6.1 Binondo - Historic Site as Testing Ground for 'Surface' Interventions	137
6.2 Santa Ana - Post-industrial Site as Testing Ground for 'Building' Interventions	151
6.3 Punta - Informal Site as Testing Ground for 'Connector' Interventions	164
<b>Chapter 7: Performance</b>	<b>181</b>
7.1 Spatial Performance: Environmental/Social Assessment	185
7.2 Reflections on Design and Context	191
 <b>Chapter 8: Conclusion</b>	 <b>206</b>
<b>Bibliography</b>	<b>216</b>

## List of Figures

Figure 0-1 Street View Manila	12
Figure 0-2 Image of fluvial flooding in Manila	18
Figure 0-3 Image of flooded street in Manila	20
Figure 1-1 Images of tsunami breaching embankment, Miyako Japan	22
Figure 1-2 Flood management approaches	30
Figure 1-3 Diagram of flood actors. Image credit: RIBA	34
Figure 1-4 Marine Aquaculture, Luoyuan Bay, Fujian Province, China	37
Figure 2-1 Historic image of Pasig River transportation	38
Figure 2-2 Historic image of Pasig River embankment	39
Figure 2-3 Historic image of Pasig River	40
Figure 2-4 Historic image of Pasig River	41
Figure 2-5 Burnham Plan of Manila, 1905	42
Figure 2-6 Colonial city. View of historic building from the American colonial period	44
Figure 2-7 Modernist city. View of flood gates in historic city	46
Figure 2-8 Globalist city. View of children bathing next to new high-rise development	48
Figure 2-9 Image of engineering-led flood management, pumping station, Binondo	54
Figure 2-10 Image of local environmentally-led waterway rehabilitation, Estero de Paco	55
Figure 3-1 Interpretation of research by design models by Frayling and Till	57
Figure 3-2 Matrix of four case study cities	60
Figure 3-3 Comparative test sites	64
Figure 3-4 Early design sketches	67
Figure 3-5 Testing and development of design strategies and tactical interventions	68
Figure 4-1 Satellite view of four case study cities	72
Figure 4-2 Images of flood events: Dhaka, New Orleans, Hamburg	74
Figure 4-3 Example of coping with water	76
Figure 4-4 Examples of low cost flood-adaptation	80
Figure 4-5 Example of floating building for Korail, Dhaka	81
Figure 4-6 Example of engineering-led flood protection, New Orleans	82
Figure 4-7 Example of reverse engineering	87
Figure 4-8 Example of phased master planning of HafenCity	88
Figure 4-9 Diagrams of urban design principles for master plan development of HafenCity	93
Figure 4-10 Categorisation of flood adaptation	95
Figure 4-11 Universal flood management catalogue	96

Figure 5-1 Satellite view of Manila and mouth of Pasig River	98
Figure 5-2 Aerial view of Manila and Pasig River	100
Figure 5-3 Image of research on cities and flooding	102
Figure 5-4 Diagrams of fluvial and pluvial flood management	108
Figure 5-5 Design strategies	110
Figure 5-6 Tactical design components	114
Figure 5-7 Early design strategy for historic site	118
Figure 5-8 Early tactical designs in historic site	119
Figure 5-9 Early design strategy for post-industrial site	120
Figure 5-10 Early tactical designs in post-industrial site	121
Figure 5-11 Developed design strategy and tactics for historic site	122
Figure 5-12 Developed spatial components in site indicating ideas for urban design	123
Figure 5-13 Flooding of Makati, Manila's business district	124
Figure 5-14 Image of flooding to roof level	126
Figure 5-15 Marikina, East Manila	128
Figure 6-1 Drawing of overlaid strategies, neighbourhood tactics and design interventions	130
Figure 6-2 Map of Manila showing locations of historic, post-industrial, informal test sites	132
Figure 6-3 Satellite view of historic site	134
Figure 6-4 Satellite view of post-industrial and informal neighbourhood	135
Figure 6-5 Elevation of Binondo - historic site A	136
Figure 6-6 Elevation of Santa Ana - post-industrial site B	150
Figure 6-7 Elevation of Punta - informal neighbourhood C	164
Figure 7-1 Evaluation Diagram	182
Figure 7-2 Evaluation of historic site (A)	184
Figure 7-3 Evaluation of post-industrial site (B)	186
Figure 7-4 Evaluation of informal site (C)	188

## List of Illustrations

### HISTORIC SITE

Illustration 6-1 Historic site overview	140
Illustration 6-2 Historic site photographs	141
Illustration 6-3 Site A Plan of historic neighbourhood	142
Illustration 6-4 Site A Axonometric of historic neighbourhood	143
Illustration 6-5 Site A Section through historic neighbourhood	144
Illustration 6-6 Site A Photographs of historic neighbourhood	146
Illustration 6-7 Site A Perspective 1 of historic neighbourhood	147
Illustration 6-8 Site A Moments in historic neighbourhood	148
Illustration 6-9 Site A Perspective 2 of historic neighbourhood	149

### POST-INDUSTRIAL SITE

Illustration 6-10 Post-industrial site overview	154
Illustration 6-11 Post-industrial site photographs	155
Illustration 6-12 Site B Plan of post-industrial neighbourhood	156
Illustration 6-13 Site B Axonometric of post-industrial neighbourhood	157
Illustration 6-14 Site B Section of post-industrial neighbourhood	158
Illustration 6-15 Site B Photographs of post-industrial neighbourhood	160
Illustration 6-16 Site B Perspective 1 of post-industrial neighbourhood	161
Illustration 6-17 Site B Moments of post-industrial neighbourhood	162
Illustration 6-18 Site B Perspective 2 of post-industrial neighbourhood	163

### INFORMAL SITE

Illustration 6-19 Informal site overview	168
Illustration 6-20 Informal site photographs	169
Illustration 6-21 Site C Plan of informal neighbourhood	170
Illustration 6-22 Site C Axonometric of informal neighbourhood	171
Illustration 6-23 Site C Section of informal neighbourhood	172
Illustration 6-24 Site C Photographs of informal neighbourhood	174
Illustration 6-25 Site C Perspective 1 informal neighbourhood	175
Illustration 6-26 Site C Moments of informal neighbourhood	176
Illustration 6-27 Site C Perspective 2 of informal neighbourhood	177

**EVALUATION**

Illustration 6-28 Comparison of sites	178
Illustration 7-1 Collage of urban stage in the historic quarter	180
Illustration 7-2 Collage of covered water square in the historic quarter	196
Illustration 7-3 Collage of raised buildings over existing urban grain	198
Illustration 7-4 Collage of temporary floating housing with flood protective berm	200
Illustration 7-5 Collage of raised walkways and community shelter	202
Illustration 7-6 Overview collage of tactical interventions	204



## Acknowledgements

Thank you to Susannah Hagan for her continued time, energy and dedication as my supervisor throughout this project. Thanks to Alex de Rijke and Fernando Rihl, my secondary supervisors, and the administrative team at the Research Office for their support.

For the Manila case study, thanks to Paulo Alcazaren, Dominic Galicia, Dean Joey Yupangco for their valuable insights and information on Manila's history and current urban development. Thanks to Felino Palafox Jr. for the information on Manila's master plan projects and discussions on the city's future directions.

For the information on Manila's flood management, thanks you to Secretary Rogelio Singson of the Department of Public Works and Highways and Francis Tolentino, Chairman of the Metro Manila Development Agency, for the information and discussion on Manila's flood management plans. Thank you to the University of the Philippines, their Project NOAH and DREAM/PhilLiDAR departments for providing electronic city and flood hazard maps of the sites in Binondo and Santa Ana, Manila. For project site visits in Manila, thanks to Rick Holland, from Grundfos manufacturing, and Olivia Castillo, who provided access to Binondo's pumping station and discussion of ideas around flood-engineering plans in Metro Manila. Thanks to Michael Rubio, former director of rehabilitation programme of the Pasig River tributaries and, Robert So, founder of 'Eco-System', and their valuable insights of their work on local wastewater treatment processes.

For the development of the design work, thanks to Mark Gatterell, from the University of Plymouth, for his insights on flood management, and Geraldine Wharton, from Queen Mary University, for the discussion on 'green' infrastructure. Thanks to Priti Parikh, Cassidy Johnson, Peter Bishop, Sarah Bell from the UCL for discussions on flooding and urban design in formal and informal neighbourhoods. I also wish to thank to colleagues and friends, Almudena Cano, Christine Hawley, Damien Assini, Gordon Yip, Kaizer Hud, John Zhang, Jona Piehl, Julien Fron, Saba Golcher, Tom Cubitt, Yip Wing Siu, for suggestions and comments on the development and testing of my design research.

I acknowledge the AHRC scholarship and the AHRC Research Training Support Grant, which enabled me to undertake this programme of study through three years of support, and the fieldwork in Manila, Philippines.

Thanks to my parents, Victoria and Jose Zaide, Jr., for their past and current support.

## Authors declaration

During the period of registered study in which this thesis was prepared the author has not been registered for any other academic award or qualification. The material included in this thesis has not been submitted wholly or in part for any academic award or qualification other than that for which it is now submitted.

A handwritten signature in black ink, appearing to read 'B. J. J.', written over a horizontal line.

Signature

15 February 2018

Date



Figure 0-1 Manila street view, 2014

## Introduction

### Floodscape Urbanism: Manila at Risk

Over the next two decades, the number of people affected by river flooding worldwide could increase from 21 to 54 million, according to a recent study by the World Resource Institute (2015). The expansion of cities in flood-prone areas, combined with the adverse impacts of climate change, such as heavier rainfall and rising sea levels, leave future populations and economies exposed to potential disaster. With these risks in mind, such cities urgently need to set new environmental, economic and social priorities within 'climate conscious' urban planning and management. Conventional hard engineering approaches that dominated the discussion of flood management in the nineteenth and twentieth century cannot adequately deal with the complexity of these emerging challenges, alternative design strategies for such built environments need exploring.

With much ground already covered on cross-disciplinary approaches in flood risk management, this thesis will specifically consider the discussion of flood adaptation through the lenses of ecological urbanism and architectural design. At issue is the fluid edge between city and water, captured in the term 'floodscape', a cityscape affected by fluctuating water levels. The thesis argues the importance of urbanism as the key driver to integrate the environmental and social concerns of the city in a holistic and critical way. Floodscape Urbanism therefore can be understood as a potential bridge between urbanism and hydrological cycles, with design providing a crucial framework to think about and act on environmental, technical, economic and socio-cultural challenges. Manila, the focus of this thesis, is an extreme case of a flood-prone city. As a study, it seeks to balance vital flood management with creating places suitable for urban life that many cities in the global south are facing or will face.

The original contribution of the thesis is the development of flood adaptation strategies for Manila by design, strategies that are to some extent transferable to other cities similar in climate, location and socio-economic conditions. The thesis questions what role design and the designer can play in the transition toward a flood-responsive city. It further asks how design-led flood adaptation approaches can be tried, tested and translated into this particular context. To this end, the thesis examines flood adaptation as a strategic urban design process at master plan scale,

and as architectural design propositions at neighbourhood scale. Manila's recent move to address flood risk provides an opportunity for architects to become involved in the long-term planning and implementation of flood adaptation, and to re-engage with the question of the quality of the urban fabric that the city critically needs to address. The role of design research is to demonstrate that such an integrated and design-led approach is not only a feasible but also a desirable long-term investment for Manila.

The aims of this study are threefold. The first is to offer insights from 'ecological urbanism' as presented by Mohsen Mostafavi, Susannah Hagan, Charles Waldheim, Kelly Shannon, and others, which presents a framework for urban design that addresses the much needed environmental and cultural recalibration of cities. With an emphasis is on environmental systems to restructure urban sites, ecological urbanism establishes a critical role for design in cities at flood risk. Second, the study presents modes of knowledge exchange that enable architects to learn from other disciplines and other cities in order to expand the scope of their effective field of action. And third, the study argues for the importance of the holistic spatial development of environmental, economic and socio-cultural adaptations through design. The thesis, therefore, shifts the architect's attention from the building to include the infrastructural scale, and expands the conceptual and practical frameworks necessary to engage with one of the most challenging environmental risks cities face today.

The thesis is divided into a written part and a design project. The written part establishes the theoretical framework for design-led flood adaptation, and outlines the methodology of knowledge exchange. The design project consists of interventions for Manila at both urban and architectural scales. As the main part of the thesis, it considers the roles of design and the designer in this city first at the scale of the river and the city, then at the scale of three particular neighbourhoods affected by fluvial (river) and pluvial (surface) flooding. Both types of flooding are associated with the heavy rainfall that regular occurs in the Philippines during the wet season between June and October. The written thesis runs in parallel with the design project, which in part one is used to establish a body of knowledge to inform- and in part two is used as a means to reflect on - design.

The research methodology is divided into three types: research for, into, and through design. These are synthesised in a set of design proposals. A comparative analysis of precedent studies in the written part of the thesis reveals transferrable design tools and strategies for cities dealing with flood risk. These form the basis of a catalogue of flood adaptation tools some of which were chosen and tested in the Manila case studies.

## Written Thesis

The first chapter of the thesis establishes environmental engineering and urbanism as key drivers for helping cities at flood risk. It considers the evolution of Ecological Urbanism, and how architecture has to take on a critical role in the move toward such an ecosystemic city model. The need to reengineer and redesign cities for a changing climate and increased urban populations requires new conceptual models and practical methods for design. The architect's engagement in flood management projects is crucial in deciding how new infrastructures can be introduced into existing urban fabric, and what formal and social impact these may have on the city. This chapter therefore challenges us to rethink cities at floodrisk through their natural hydrology, the existing urban grain and most importantly through human occupation, and to consider the contribution that architects can bring to the discussion.

The challenges to introducing urban and architectural flood adaptation design strategies along Manila's main water artery, the Pasig River, are discussed in Chapter Two. This section considers Ecological Urbanism as a framework for addressing Manila's environmental, economic and socio-cultural challenges through a comprehensive design strategy for the much-neglected embankments of the Pasig River. Recent engineering-led flood management plans by the government as well as newly established policies to improve the river system are regarded as potential catalysts for design innovation in the city. In spite of this significant investment in the rehabilitation of the river and flood protection, however, this section uncovers the lack of a coherent design vision. The chapter on Manila is followed by the Design Methodology, which sets out the framework to test and develop universal flood adaptation strategies and particular tactical interventions in the city.

The fourth chapter begins with three case studies of urban flood management practice in Dhaka, New Orleans and Hamburg - cities that vary greatly in terms of their approach and capacity to deal with flood risk. The choice of cities is based on two criteria: a city's ability to invest in flood adaptation, and its preparedness to manage institutional change. The cities' awareness and implementation of environmental and urban strategies also informed the analysis. The choice of cities, however, is not to be understood as examples of best (and worst) practice, but instead as highlighting the importance of understanding local governance and economic conditions as well as water regimes before considering appropriate design interventions.

On a strategic scale, the fifth chapter examines how design can contribute to an environmentally-led flood adaptation plan that reorients the city to the river, resilient to future unpredictable changes in climate and urban development. It also asks how such a strategic plan can be deployed tactically in incremental design interventions, able to respond to specific physical and territorial site conditions on a neighbourhood scale. The aim of the study is not only to explore how the Pasig's riverbanks can become more flood-resilient, but also how design can provide the opportunity for new forms of economic and socio-cultural activity. Applied strategically, ecologically-minded design is able to embrace the complexities of scale and time that the flood adaptation along the Pasig requires.

Chapter six considers design-led flood interventions for two specific and contrasting segments of the Pasig River, which represent the city's abandoned historic core and a typical industrial stretch in transition. It examines how the sites' particular densities and types of stakeholdership affect the neighbourhoods' capacities to absorb flood impacts and invest in flood adaptation. The chapter outlines how these distinct conditions inform the nature and scale of adaptation measures, influencing the choice of design tactics, and what formal and social impact the designs could have on each of the neighbourhoods. Seen through the lens of Ecological Urbanism, the new insertions take into consideration environmental, economic and social values where previously only hard engineering performance and costs were considered. The chapter also discusses how designing for a floodscape requires a shift in design thinking, and the active development of a broader understanding of transferable approaches and technologies.

### **Design Project**

Part two of the thesis, the design project, first analyses Manila's environmental, governance and land use to develop a comprehensive strategic framework for design. The design component of the thesis explores the formal and civic dimensions of architectural design at the strategic scale of the river and tactical scale of the neighbourhood sites. The findings of the research identify adaptive applications for Manila that can be transferred to other cities facing flood issues.

The thesis Conclusion considers the site studies in relation to each other, and highlights the importance of the role of design and the designer in the exchange of knowledge for cities at flood risk. In the discourse concerning environmental engineering, governance and architecture/urban design, the architect's role is perceived as giving shape to the urban ground that hosts dynamic environmental processes and supports urban life.

- Blank Page -





Figure 0-2 Fluvial flooding Manila, 2009





Figure 0-3 Flooded street in Manila August, 2012. Image credit: Noel Celis/AFP/Getty Images  
flooded street in Manila August, 2012. Image credit: Noel Celis/AFP/Getty Images







Figure 1-1 Images of tsunami breaching embankment, Miyako Japan, 2011. Image credit: Toshifumi Kitamura/AFP/Getty Images

## Chapter 1: Towards ecological practice

Imagining an urbanism that is other than the status quo requires a new sensibility – one that has the capacity to incorporate and accommodate the inherent conflictual conditions between ecology and urbanism. (Mostafavi 2010, p.17)

In the introductory chapter of 'Ecological Urbanism', Mohsen Mostafavi (2010) frames the discussion of the contemporary city through the lens of ecology. The challenge put forward is how an ecological understanding between the natural and artificial environments can provide alternative models of urbanism fit for the 21<sup>st</sup> century. The ecological perspective to urban design is not new (Spirn 2014), but increasing environmental pressures question how the 'project of urbanism' needs to be reimagined in order to establish a greater synergy between environmental function and urbanity (Hagan 2015).

The World Economic Forum (2016) has identified water crises and failure of climate mitigation and adaptation as the highest risks in the decade. The Dutch Special Envoy for International Water Affairs, Henk Ovink, has stated that for the next decades and the ones following that, water-related crises will be among the greatest that will impact us (Ovink 2014). In a keynote speech at the RIBA, he pointed out that 'the cities and systems we have are not fit for the future. We must change the way we think about water management, not just after a flood, but before they happen.' (Ovink, speaking at 'Creation from Catastrophe: How Architecture Rebuilds Communities' 2016).

Over the last decade, the design community has started to explore the relation between flooding and the city. The 2<sup>nd</sup> International Architecture Biennale in 2005 directly engaged with the global impact of climate change. Entitled 'The Flood', the theme of the Biennale explored the relationship between design, the critical infrastructure needed in flood-prone areas and the engagement with affected communities (de Baan 2007). More recently in 2010, the Museum of Modern Art in New York hosted the exhibition 'Rising Currents' that questioned how human beings have reshaped the landscape and how one can design to utilise natural environments in a more sustainable manner (Bergdoll 2010). Making a case for a water-centric form of urbanism, Bruno de Meulder and Kelly Shannon argue that the need for urban design combined with water management in cities is so 'self-evident that it is

seldom seriously considered' (De Meulder and Shannon 2013, p.4). But in the period since the Brundtland Report (1987) on sustainable development, the critical contribution design can offer still needs to be understood and acknowledged (Hagan 2015). To take a more central role in the ecological transformation of our cities, the challenges for designers are perhaps as Mostafavi puts it, first to critically engage with ecological practices, and second, to find alternative ways to consider the scope and scale of the city.

This chapter looks at Mostafavi and Hagan's arguments by looking at the evolution of flood-adaptive design approaches, and the scope for ecological frameworks that design can engage with. It addresses issues from the literature on flood management policy and ecological urbanism in order to fill an important gap: the role of design in a city at flood risk. It builds on the premise that conventional hard engineering-led flood management practices are increasingly inadequate to respond to extreme weather events, uncertainties in climate and the effects of urbanisation. As an alternative, adaptive flood management looks at a diverse set of flexible solutions at different scales and with a range of approaches. In contrast to the fixed and inflexible solutions of conventional flood management, flood adaptation seeks to find opportunities to create urban water systems that adapt and transform with flood events. Uncertainty therefore becomes an explicit driver of not only coping with change, but learning to do things better (Brown 2009).

## 1.1 Conventional to adaptive flood design

The 2015 OECD Report on 'Cities and Climate Change', states that by the middle of this century, the majority of the world's population will live in cities by the coast or near river deltas and estuaries (OECD 2015). With the movement of people to cities, the effects of urban development and building in flood prone areas will increase vulnerable exposure to flooding. Furthermore many regions in the world are expected to experience a rise in the frequency, intensity and duration of extreme precipitation events as a result of climate change. In view of these trends in urbanisation and climate change, our cities are not adequately prepared for these changes and relevant planning and building practices will need to be reconsidered to address the increased risk of urban flooding.

The majority of today's flood management of cities can be characterised as engineering approaches. For natural flood risks from coast or rivers, the dominant flood control strategies rely on technocratic solutions such as dykes or flood wall construction. Urban flood risks, such as pluvial flooding or flooding from sewers, are addressed mainly through drainage infrastructure. However, out-dated or overloaded drainage systems are unable to cope with intense levels of urban run-off (Karvonen 2011). Urbanisation also contributes to the increase in the level of flood risk. Urban development through the construction of buildings, roads and infrastructure, increases the proportion of impermeable surface, and while undeveloped land can absorb up to 90 percent of rainwater, urbanised areas, with significantly less infiltrate capacity, creates larger volumes of water run-off (Karvonen 2011). Studies conducted in the lower Netherlands on the impacts of urbanisation over the past 50 years also suggest that the level of flood risk for the region has increased seven-fold (Aerts 2011). Combined with the high variability in weather patterns and the unprecedented increase in flood events, raise doubts concerning the effectiveness of our engineering.

From an urban design point of view, engineering solutions for flood protection can often be at odds with the design for urban activities set out by spatial planners. In a paper on 'Innovative Flood Defences in Highly Urbanised Water Cities', Bianca Stalenberg (2011) highlights how flood defences, by their very nature, can create obtrusive physical barriers between the urban spaces and the city's coast or river edge. In densified urban areas, the competition for space also narrows the choice of flood defence strategies to vertical floodwall systems, since softer dyke constructions require wider footprints. As engineered flood defence systems also require regular access for operation or maintenance work, these barriers are predominantly designed as mono-functional structures. This physical and visual segregation breaks an important link between the city and its water edge. Stalenberg further points out that the conflict between flood control and urban planning, is not only one of space, but also of time. The specifications for a functioning flood defence differ from those designed for urban activity. The technical lifespan of a flood retaining structure is at 100 years, compared to the functional lifespan of an urban structure at only about 20 to 30 years. Stalenberg concludes, that early interaction between spatial planning and engineering approaches can lead to innovative ways of combining the design of flood protection to incorporate the aspirations of urban planning.



## Adaptation

A report on 'Future Proofing Cities' (Godfrey and Savage 2012) prepared by the UK Department for International Development, Atkins infrastructure consultants and the University College London on, states that relying on engineered infrastructure is no longer enough to address the challenges of climate change, and that alternative forms of managing environmental risk need to be explored. The report highlights the complex and interconnected nature of environmental risks that require multiply-faceted solutions. Furthermore, while hard-engineered measures present an option to address flooding, this requires significant economic input (Hanson and Nicholls 2011). At policy level, the approach to flooding has shifted from 'protection' – trying to 'control' the effects of climate change – to 'adaptation' – to make the necessary adjustments to the natural and urban environment to 'manage' the effects of climate change (IPCC 2007).

An economic argument for 'adaptation' is presented in the Stern Review, which 'examines the evidence on the economic impact of climate change and considers the complex policy challenges involved in managing the transition to a low-carbon economy and in ensuring that societies can adapt to the consequences of climate change that can no longer be avoided' (Stern Review 2006, p.1). With climate change presenting global risks, the report calls for urgent action. In particular, it points to the need for early intervention, investments that would in the long run outweigh the costs of waiting.

The concept of 'adaptation' has several implications for cities at high flood risk. A report carried out by the OECD (Nicholls et al 2008) identified high increase in levels of exposure to flood risk, especially in rapidly growing coastal cities in Asia, reflecting the trend of urbanisation in low-lying areas as a result of expected economic growth. Given the importance of port cities to national economies and global trade, the report argues that the failure to develop effective adaptation strategies would have wider economic consequences beyond the scale of the city. It further points out that the development of financial strategies for flood protection and changes in land use require a long lead-in time. This underlines the importance for adaptation awareness and political will to reframe flood management approaches. The report concludes by turning the challenge of flood financing into an incentive, suggesting that investment into new alternative practices of flood management could create knowledge that would help advance other nations in the coming decades.

### Implications for design

In order for design to enter the discussion of flooding, it needs to be prepared to critically engage with urban adaptation. Urbanist Charles Waldheim, whose research examines the relation between landscape, ecology and contemporary urbanism, maintains that 'the emergent topic of urban adaptation to the effects of climate change is among the most pressing areas of research for those engaged in the built environment' (Waldheim 2006). Such research is reflected in the practice of 'landscape urbanism'. In his essay on landscape strategy, James Corner (2006) posits that ecology can serve as a useful model for urban design as it can synthesise approaches from different disciplines, work across scales and deal with time open-endedly. These principles are also found in the language of contemporary policy papers on climate change adaptation:

**Multidisciplinary Frameworks.** Flood adaptation goes beyond looking at singular means of flood protection and instead uses a systemic way of approaching flood risk reduction that can have socio-economic and environmental benefits. The European Environment Agency (EEA) 2013 report on 'Adaptation in Europe' for example describes three different adaptation categories: 'Grey', 'Green' and 'Soft'. Where 'grey' adaptation refers to civil engineering projects, 'green' adaptation looks into ways of making use of nature, while 'soft' adaptation focuses on managerial and policy approaches. The issue of flooding therefore can be approached via a combination of approaches, from 'grey' engineering-led dyke building, 'green strategies', such as natural wetland creation, to soft policy approaches, such as the introduction of early warning systems. The role for design in flood adaptation can therefore contribute to the 'process of managing the different assets that sustain' our cities, where the 'assets include built infrastructure and our natural environment, as well as our culture, society and economy' (EEA 2013).

**Scalar Interventions.** Spatial planning and design are thus key disciplines to address future flood risk in new ways. This transition from defensive to adaptive forms of flood management is currently being led by cities that have experienced severe flood events over the last 50 years (Hill 2011). Dutch cities, for example, are shifting from traditional methods of separating land and water to giving more space for water ('Room for the River' Rijke et al 2012). Rotterdam, with a projected sea-level rise estimated around 50cm to 85cm by 2100 and land-subsidence of 3mm to 4mm a year, is initiating a diverse set of adaptive measures which include multifunctional flood defences for the city centre, urban water plazas, an extensive green roof programme, and buildings that can withstand or float on water. The

shift toward a design-inclusive approach is also visible in changes made by the Dutch at national policy level. Their Netherlands Water Management Policy document (2000) recommends a 'good mix of spatial and technological measures' to address the risk of water-related problems, with an emphasis placed on the exploration of spatial measures, such as increasing the capacity of flood plains and water retention areas.

**Temporal Planning.** Design also offers several ways of conceptualising time, and differs from the predictive approach of engineering. The development of design solutions relies less on projections, and is more exploratory and open-ended. This allows for various scenarios to be considered, and to open up the space for alternative possibilities, an approach that is more appropriate to deal with uncertainty. The European Environment Agency (EEA) 2013 report, for example, highlights the importance of responding to floods as well as reacting to them, with a differentiation between short-term and long-term planning: 'Risk reduction and prevention in the short- and medium-term will primarily address socio-economic developments and climate variability to reduce the impacts of natural and technical hazards, while adaptation aims at developing longer-term planning to address climate change impacts' (EEA 2013, p.15).

### **Transitions in flood management**

Many cities have already started to take on the challenges of flood adaptation. These adaptations have mainly evolved through a matter of learning by doing, and allowing for innovation and experimentation in the design process (Aerts 2011). A city's ability to adapt continuously to change, and to attract and generate economic activity and investments makes them sites of interest in the discourse of flood adaptation. As the designs for flood adaptation today will affect the city's vulnerability to flooding in the future, linking adaptation measures to on-going investments in infrastructure and spatial planning is key to secure the longevity of the adaptation measures. Flood adaptation therefore becomes a challenge to integrate planning and investments opportunities that have spatial and temporal dimensions (Hill 2011).

As cities adapt to the challenges of future conditions, the exchange of knowledge and practice of urban flood management between cities is vital. This will allow them to learn how to, and how not to, adapt to future flood risks (Aerts 2011). The question is not whether, but how quickly cities will learn to adapt. In terms of the role of design, one needs to consider

when in the adaptation process design needs to be integrated into flood management, and secondly which stakeholders need to be engaged.

Successful design examples can of course serve as models for transition. Trends in contemporary urban waterfronts for example demonstrate the value of flood-resilient development that can generate economic investment, social change and environmental change. Two recent developments in the Netherlands and Japan are just two examples of innovation and experimentation in waterfront adaptation.

A paper on the 'Consequences of Urban Riverfront Development in Northwest Europe' (Spits et al 2010) identifies how flood conditions in the Netherlands reframed floods policy toward a flexible approach. Socio-economic pressures and lack of land for urban expansion have informed innovative approaches to permit building in flood plains, provided that the effects on the water discharge capacity are compensated and that flood adaptation measures are funded by the developers. Rotterdam provides an example for a flood management strategy at different scales. On a macro scale, the Maeslant Barrier and a large number of upstream dams (flood protection) prevent turbulent floods, which enable the development of floating new districts (local flood adaptation). Plans to revitalise the city's former shipping harbour include 1200 housing units along with retail and restaurants in the district of Stadshaven. The harbour is also the site for innovative floating housing typologies that use solar panels and heat exchangers. These typologies and the potential for decentralised deployment make this an interesting model for calm waterfront areas (Hill 2011).

In Japan, after a major dyke failure in 1986 in Ibaraki Prefecture, the country has invested into the construction of large infrastructural super-dykes (Stalenberg 2012). These have been implemented along rivers in Osaka and Tokyo in the 1990s and are now being considered as a strategy that can be extended along many of Japan's urban waterfronts. The flood defence averages 10 meters in height and 300 meters in width, which allows for the development of high-density housing, roads and public parks. The elevated height acts as flood prevention and establishes views to the water. On-going debate around the costs and long period to construct raise questions about the transferability of this form of flood 'grey' adaptation (Stalenberg 2012) or whether developing cities will need to consider alternative models.



Figure 1-2 Flood management approaches Top: Flood Control Levee Maasvlakte Rotterdam, 2011. Bottom: Polders, Grooteschermer 2011. Image Credit: Edward Burtynsky

## 1.2 Flood-adaptive city models

From a design point of view, the scope of ecologically driven design has remained limited (Mostafavi 2010). The challenges of flooding in the city require design to find practical approaches that enable designers to work more effectively at a larger scale. Ecological models that provide the framework to understand the complex environmental, economic, political, social, and cultural factors on a site have been addressed in the past and more recently, and they still present critical conceptual frameworks for how to work toward a flood-adaptive city in the future.

The separation of water and urban activity was already being challenged in the mid-20th century by Ian McHarg in his 1969 publication 'Design with Nature', which examined the interrelationships between nature, technology and society, and recognised the interconnectedness of the urban community and their material surroundings. It also opened up the possibility of a larger debate that includes ecologists, urban and landscape designers, spatial planners and local residents to formulate how contemporary cities can be reworked into more flood resilient as well as more desirable environments. McHarg argues, 'The flood-plain parameter must be attributed a particular importance because of its relation to loss of life and property damage [...] there is every reason to formulate a land utilization [sic] policy for flood plains related to safeguarding life and property (McHarg, cited by Steiner 2006, p.75).' While McHarg's model refers to open land, it could also be applicable to an urban setting.

More recent studies pioneering interdisciplinary research toward sustainable urban water management is the work of Rebekah Brown on 'Water Sensitive Cities' (Brown 2009), which explores more sustainable adaptive practices – including integrated planning and implementation strategies. Brown argues that over time, climate change risks that cities are facing will change. It is therefore important to view flood challenges and related design responses as dynamic and capable of spatial and temporal change.

In order to translate the concept of adaptive water management into design terms, the 'Water Sensitive City' model requires further articulation. Brown proposes the integration of the following three design-led concepts into urban planning: The use of water supply catchments, the provision of ecosystem services and the establishment of water-sensitive communities. The first principle is the diversification of water systems, such as controlling rainwater catchment, wastewater recycling, storm water harvesting and end-use conservation. The second principle, the integration of ecosystems into the urban water fabric, serves the dual function of controlling flood impacts and generating additional value for the city as sources for sustainable water management, microclimate control and potential areas for urban food production. The third principle, creating water sensitive communities, is key to translating this approach into sustained practice. Brown highlights the importance of integrating these principles into the social and institutional context, and using urban design and the exchange of best thinking and practice in urban water management as tools in the transition toward a 'Water Sensitive City'.

To consider the role of institutions, the model for an 'Urban Water Management Transitions Framework' (Brown et al. 2009) is used as a tool to assess the transition of a city to adaptive flood management. Based on water management practices from the developed world, the model provides fine-grained gradation from conventional to adaptive water systems, drawing the co-relation between water management evolution and particular socio-economic drivers. In this framework, the drivers for water management become increasingly complex. The majority of cities come under the linear water management models (Duffy 2009), and the notion of a truly 'Water Sensitive City' – one that applies adaptive, multifunctional infrastructure and urban design principles – still remains undeveloped (Brown 2009).

### Barriers to transition

Some of the barriers in the transition toward flood adaptation lie in how different actors and agencies engage differently with uncertainty. In order to create effective interaction between urban and spatial planners with multiple stakeholders, it is therefore useful to deconstruct the concept of risk within the context of flood adaptation.

The breakdown of the concept of risk into a generic equation: Risk = Hazard x Vulnerability x Exposure (Crichton 1999) provides a useful starting point. From this perspective, the risk of flooding is determined by the presence of a potentially damaging event and being subject and susceptible to its impacts. This definition however would suggest that design involvement limits itself to a problem-solving approach, i.e. decreasing vulnerability and exposure. In spatial planning terms, decreasing vulnerability could be addressed through the use of flood-proof material and building construction, and exposure could be reduced through the implementation of effective land use planning. An alternative definition of risk is provided by the Intergovernmental Panel on Climate Change: 'the probability of occurrence of hazardous events or trends multiplied by the consequences' (IPCC 2014). The emphasis on consequences for people, and the natural and/or built environments (Evans et al. 2004) provides a more holistic view of flood risk and links spatial planning to other disciplines involved in risk reduction.

A different interpretation of risk is provided by urban planner Tony Lloyd-Jones (2013), who suggests that within the context of urbanisation, flood risk should be viewed in conjunction with the capacity to respond. In this case, flood adaptation will need not only focus on reducing the probability of flood consequences, but place more emphasis on developing the capacity of urban systems, institutions and communities to deal with hazards, and take advantage of opportunities to formulate a new understanding of integrating floods and urban development. By placing risk reduction alongside adaptive capacity building, this definition of risk recognises the need for flexible and dynamic approaches that stretch across sectors and jurisdictions to build flood resilient cities. The breakdown of the concept of risk therefore contextualises the role of design, and with regard to flood adaptation, spatial planning becomes closely connected with institutions, governance and financial investments. Partnerships become key to developing principles that are acceptable across sectors in order to formulate coherent strategies toward flood adaptation.



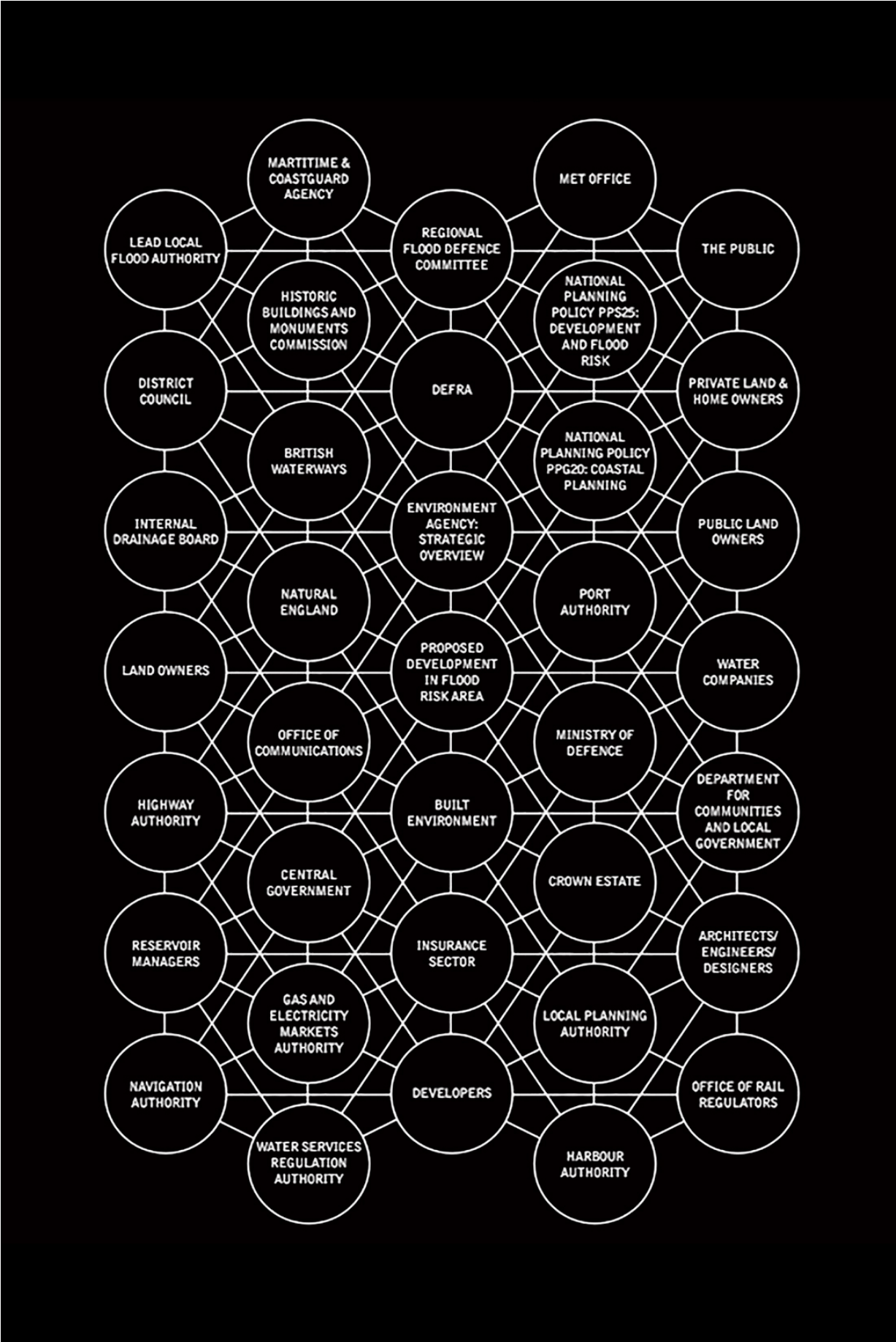


Figure 1-3 Diagram of flood actors. Image credit: RIBA

The concept of risk outlined above only partly explains the resistance to adaptive forms of flood management. Other types of barriers identified in the Transitions Framework toward flood adaptation (Brown 2009) include organisational resistance, lack of political will, limited regulatory incentives, and unsuitable institutional arrangements. These all hinder effective long-term planning on an institutional level, and therefore lead to policy failure at implementation level. The expansion of sectors and disciplines involved in the planning of flood adaptation requires institutional change. Barriers to the transition toward flood adaptation do not necessarily lie in the unavailability of technological solutions, but in the difficulty of generating the institutional change required to put available solutions into practice (Brown 2009). Insufficient knowledge and skills for the planning and implementation of flood adaptation is a further barrier. 'Path dependence' – the notion that decisions are limited by past knowledge – has been identified as a key barrier to institutional change (Geels 2004; Walker 2000). This suggests that investment in existing systems remains unchallenged due to unreflected practice, and therefore prevents alternative solutions to be adopted. The barriers listed above suggest that effective design-led approaches require robust institutional support.

### 1.3 Ecological Urbanism and flood resilience

Floods cannot be addressed without vital engineering or institutional commitment. The shifts towards adaptation described earlier in the chapter show a willingness to approach the issue of flooding in an integrated way at policy level. But this cannot be done through policy, management and engineering alone (De Meulder and Shannon, p.6). The complexity of environmental and urban change needs also to be addressed through alternative models for urban design and design practice, in order to move toward creating more flood resilient cities.

This complexity could be addressed through 'landscape urbanism' – the precursor to ecological urbanism – that operates with a multifocal perspective and across scales. Landscape, as Charles Waldheim, (2006) observes in his essay on 'Landscape as Urbanism', can act as a medium for construction. He presents landscape as a layered and synthetic ground that can be organised and designed to respond first to the environmental pressures of a site, but also to socio-cultural and political-economic characteristics. The alignment of architecture, engineering and urban planning with landscape is also highlighted in Pierre Bélanger's (2016) book on 'Landscape as infrastructure', which argues for the strategic design of 'infrastructural ecologies'. 'Water Urbanism' (De Meulder and Shannon 2014) uses the structuring principles of

water engineering, to give shape to urban form, and thus presents an alternative ecological agenda. Key to the practice of ecological urbanism is the emphasis on environmental function, and how this can 'give orientation to sustainable urbanism' (De Meulder and Shannon 2013, p.7).

Susannah Hagan's "Ecological Urbanism: The Nature of the City" makes a clear case for the role of design in the necessary ecological and cultural recalibration of our cities (Hagan 2015). The aim of Ecological Urbanism is to create balanced ecosystemic cities that can achieve the same metabolic balances as natural ecosystems. This frames urban sites as 'locations of demand for, and supply of resources' (Hagan 2015, p.4). With an emphasis on environmental systems, Ecological Urbanism presents both a conceptual and practical framework for design that can guide our cities' necessary physical transformation. It can offer alternative spatial approaches that integrate 'necessary environmental engineering with the city-as-culture' (Hagan 201, p.6), and therefore a lens for design that faces up to the challenge of urban flooding.

With a changing climate and sharp rises in the urban population, particularly in Asian cities, Mostafavi argues that 'conventional methods of planning are unable to respond to their rapid rates of transformation' (Mostafavi 2010, p. 39). The future conditions of at flood-risk cities, and therefore what type of form of flood protection they may require, cannot be accurately predicted. Given such complexities, no single flood protection strategy can be assumed to address all types of urban flood conditions. Cities will need to consider a range of possible measures in the planning process, and also learn to exchange best practice with other cities facing similar flood concerns. Speaking about Ecological Urbanism as a 'framework for the design of resilient cities', Anne Spirn (2014) points out that successful examples for adaptation exist, however often remain unknown to designers and urban planners. With much uncertainty about the urban natural environment, there is room for future research.

How can the conceptual framework of 'Ecological Urbanism' be applied to Manila – a city at flood risk? And how can the designers learn from other examples of design-led adaptation? If models of natural systems thinking can be the driver for design for Manila, their spatial translation and implementation into the city can only be relevant if it connects to context. The act of designing affects both the existing and new ecologies of the city, and therefore needs to be developed from a critical understanding of place, context and history (Lister 2011). Manila's historic relation to its main water artery, the Pasig River, is the subject of the following chapter.



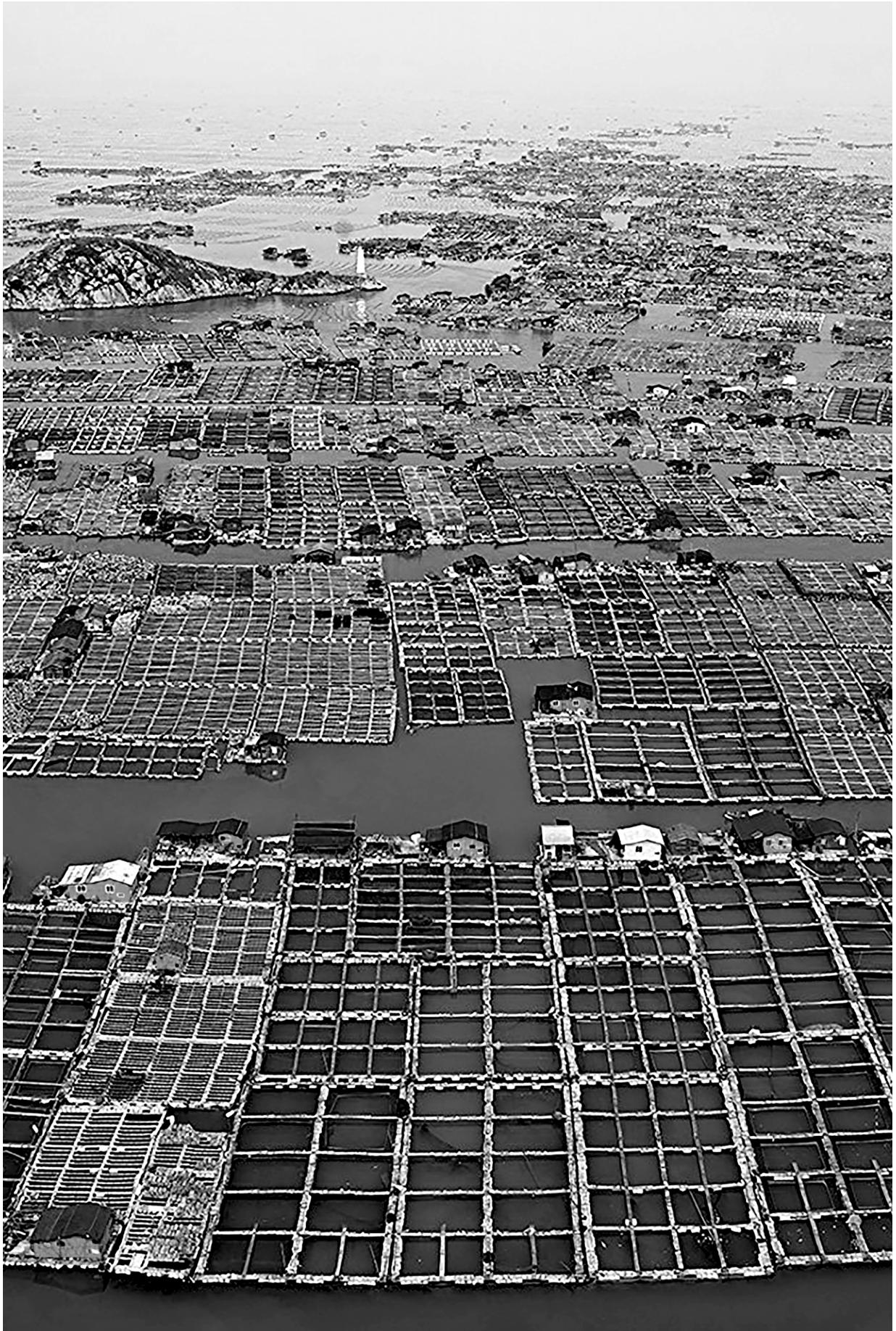


Figure 1-4 Marine Aquaculture, Luoyuan Bay, Fujian Province, China. Image credit: Edward Burtynsky





*Figure 2-1 Historic image of Pasig River transportation*



*Figure 2-2 Historic image of Pasig River embankment*



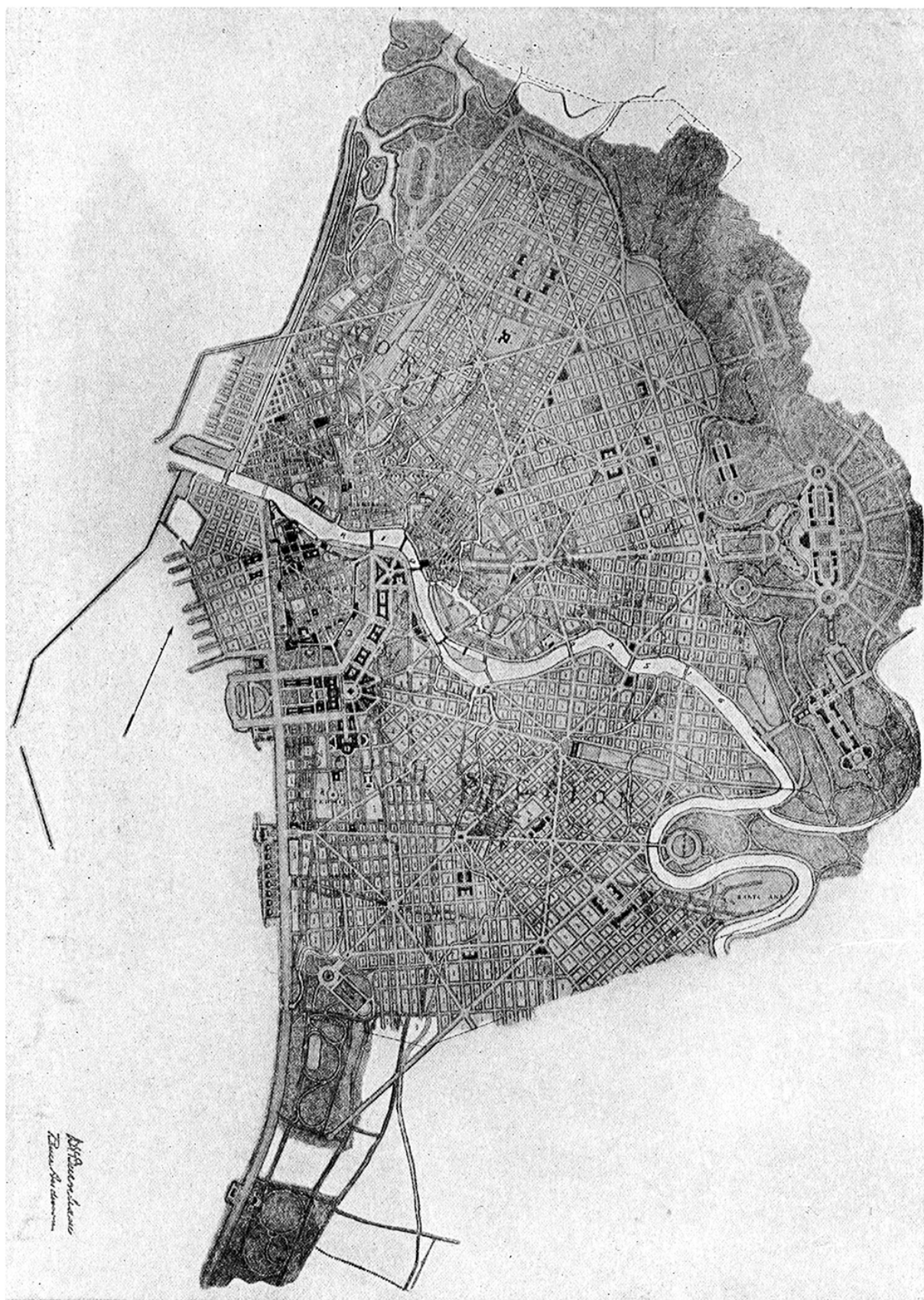


Figures 2-3 Historic image of Pasig River



Figure 2-4 Historic image of Pasig River





XXXI. PLANS FOR THE DEVELOPMENT OF MANILA, SUBMITTED TO THE PHILIPPINE COMMISSION BY D. H. BURNHAM, 1905.

The essential elements of this plan are the government center and system of proposed arteries radiating from it, the railway station, and the shore road.

## Chapter 2: Manila's Water Narratives

A brief overview of Manila's urban development over the last century provides insight into the city's disjointed relation to nature and to its hydrology. The focus of the historical analysis is to demonstrate of how types of master plans have partly created, and continue to contribute to, today's flood challenges. The city's past master plans can be characterised, first, by a representational approach which simply described the natural environment, and second, by a technological approach that attempted to exert control. Both approaches reflect top-down planning that is still prevalent in Manila that fail to see the city as part of the 'natural' environment, and to fully acknowledge the complexity of factors that contribute to Manila's urban flood challenge.

Key research on this natural systems context includes environmental historian Greg Bankoff's study on 'Constructing Vulnerability' (2003), which analyses the interconnection between the natural and man-made generation of flooding through a historical lens. The study examines flood vulnerability from an urban perspective and identifies that a 'whole range of [local] socio-economic factors such as land use practices, living standards and policy responses' (Bankoff 2003, p.224) that increase the frequency of Manila's floods. Other research draws our attention to the effect of such events on Manila's diverse urban population. A study by geographer Doracie Zoleta-Nantes (2000), for instance, examines how floods affect a range of urban groups, from Manila's wealthier households to the city's urban poor. These studies point to the institutional, economic and social contexts specific to this city that can provide important clues to develop alternative design practices.

### 2.1 Three city layers

To understand the pattern of Manila's urban development, the thesis distinguishes between three distinct master planning phases over the last century: the Burnham Plan of Manila of the American colonial period (1898–1942), the modernist reconstruction under authoritarian regime of President Marcos (1965–1986), and the present phase defined by the Philippines' efforts to become part of the global economy (1990s–present) (Shatkin 2005). These periods reflect how technological, political and economic transformations have and continue to affect the city's relation to the urban environment and its hydrological systems.





*Figure 2-6 Colonial city. View of historic building from the American colonial period*

They represent a shift from an idealised image of the City Beautiful, to a technology and infrastructure-driven city model, to the modern utopian Manila that is being projected today and built for profit by private market forces. With all three phases contributing to the physical layering of the city, they continue to define the mental image of the city that largely dominates the urban design discourse that take place in the capital today. This is problematic. Such a retrospective approach to address Manila's contemporary urban condition can only offer limited clues for design. To move toward an ecologically balanced model, and develop an alternative approach to design, the thesis examines the weaknesses of these three master plans. The analysis also establishes an understanding of the conditions in which architects must operate, including limited resources and a weak governance structure. More importantly, it also sets out how to develop plans in a city with uncertain environmental risks, how to design for the complexity of social vulnerability and how to use design to engage with these issues over time.

### **2.1.1 The Colonial City**

One of the key historic references to Manila's urban planning is Burnham's 1905 'Plan for Manila', commissioned by the United States government to adapt Manila to the modern needs of the newly established American territory (Malacañang n.d.). The plan was defined by the principles of the City Beautiful movement that aimed for formal improvements to the physical city. These included a new road system, the use of waterways for transportation, and the beautification of the city with waterfront improvements and the construction of parks, parkways and buildings. The relation between the built and the landscaped environment was driven by aesthetic principles to create a new social and civic order (Malacañang n.d.). With Manila's waterways highlighted as a key design driver, the Burnham Plan referred to the flooding of the Pasig River:

A complete development of the estero [canal] system would comport an estero connection [...] between the Pasig River and the Vitas Channel, while an amplification of the estero system connected with the Pasig River and Santa Ana and opening into the bay through the San Antonio estero might serve by its independent channels materially to diminish the danger of overflow of the Pasig. (Burnham, cited in Moore 1968, p.193)

The Burnham Plan makes further reference to the Manila's waterways, which are valued for their functional, connective and civic qualities. Architectural historian Gerard Lico comments on how the canal and river system was intended for active transportation and commercial purposes, and at the same time as an aesthetic backdrop to encourage waterfront development (Lico 2010). The riverbanks along the Pasig were envisioned as shaded river drives leading from the civic core to



*Figure 2-7 Modernist city. View of flood gates in historic city*

the periphery of the city (Moore 1968). The attention to new waterway and vehicular connections was integrated with open spaces in form of parkways and larger city parks offering respite in the new colonial city. With a plan that described a harmonious balance between landscape and buildings, pedestrians and vehicles, it is unsurprising that over hundred years on, the city's architects and planners still refer to an idealised master plan that is very far removed from the Manila of today.

The Burnham Plan did not include any explicit flood control, and only in 1909 a citywide drainage system was built in Manila for the first time (Pante 2016). Framing the river mainly for transportation or recreational purposes, the Burnham Plan made reference to the symbiotic relationship between built and natural fabric, and also recognised the importance of a spatial balance between living, working and recreation. This functional and aesthetic appreciation of nature in the city is very different from a local and ecological understanding of the city. The formalism of the City Beautiful Movement is not location-specific, and can be found again in Burnham's later plans for Washington, San Francisco and Chicago. Who is the Plan designed for? Burnham concludes, 'Manila may rightly hope to become the adequate expression of the destiny of the Filipino people as well as an enduring witness to the efficient services of America in the Philippine Islands' (Burnham, cited in Moore 1968, p.195) Typical of the time however, the City Beautiful Plan did not take into consideration the social concerns and needs of Manila's working classes.

### **2.1.2 The Modernist City**

During presidency of Ferdinand Marcos (December 1965 - February 1986) a modernist and technocratic approach to city planning was applied to Manila (Pante 2016). This resulted in a flood-control programme that was infrastructural and technology-driven. With the aim of protecting Manila's economic activities from flood-caused interruptions, Marcos' Metro Plan (Pante 2016) focussed on large-scale engineering projects, which shifted natural river flows and increased the city's drainage network (Maramag 1976). The premise for these plans was a confidence in technology being able to control nature. Reflecting the modernist ideology of the time, capital-intensive technological progress was to be used to address the range of challenges in the city, including the control of nature. Environmental concerns could be quantified, and engineered responses standardised. The origins of the flood-control programme can be found in the 1952 'Plan for the Drainage of Manila and Suburbs', and the plans that were executed during the Marcos regime followed costly infrastructure-driven 'solutions' to flooding (Pante 2016).





*Figure 2-8 Globalist city. View of children bathing next to new high-rise development*

To control the flood flow of the Pasig River, floodwalls and pumping stations were inserted along its banks, as well as the construction of a large-scale flow diversion (from the Marikina River to Laguna de Bay). The legacy of the Marcos flood-management plan was to create an expensive dependency on technology and infrastructure that lasts to this day (Pante 2016). Apart from the physical impact these technological solutions had on the physical grain of the city, the flood management framework needed to be interrogated in terms of economic feasibility, governance structure and the vulnerability of Manila's citizens (Pante 2016). This large-scale infrastructure relied on substantial external capital (Zoleta-Nantes 2000) and required the creation of an overarching governing body to oversee and co-ordinate efforts between local government departments (Pante 2016). The view held by the Marcos regime and their technocrats was that an efficient flood mitigation programme could only be constructed under authoritarian rule. The regime's failure to complete the infrastructure and mitigate large-scale floods in Manila challenged this approach.

Technology-driven solutions also failed to address social concerns, and the Marcos flood control programme can be seen less as a concern for the safety of the urban poor who had settled informally along Manila's canal and river banks, and more as a means to 'beautify' the city in order to attract tourism and external investment (Warren 2013). This actually required the removal of urban poor through relocation programmes.

### **2.1.3 The Global City**

The projection, through urban renewal projects, of Manila as a global city gained momentum in the mid 1990s (Michel 2010). In an attempt to attract foreign capital and Manila's new urban middle classes, parts of the city were and still are being replaced by exclusive high rise condominiums targeted at high end, mixed-use communities. This process is a result of Manila's extreme version of the 'privatisation of planning', (Shatkin 2005) in which the responsibility for developing Manila's urban future has been shifted from the city's public to its private sector. The city has become increasingly dependent on the involvement of private developers in large-scale and community infrastructure, often taking the shape of 'megaprojects', which are superimposed on the existing urban grain. In many of Manila's public-private partnerships, we do not find a balanced relationship between these two sectors, with the private real estate sector promoting urban transformation for corporate profit.



A new Flood risk Management Plan that was prepared in 2012 following a major flood event caused by Typhoon Ketsana in 2009. In an interview conducted on 22 July 2014, Secretary Rogelio Singson from the Department of Public Works and Highways noted that the flood management plans are based on a combination of 'grey' engineering-led and 'soft' non-structural measures. The structural plans include the construction of major dams, dykes and river walls, and the upgrading of pumping stations. The non-structural plans include investment of new flood modelling and forecasting technologies, enforcing easement requirements along the riverbanks and creating resettlement action plans for informal settlers (Balgos et al 2015). The argument for the plan is economically driven. Flooding in the Philippines causes \$160 million damage to the economy and affects 71,000 homes and displaces 3.4 million people annually (Balgos et al 2015). The overall costs for the entire master plan are estimated at P351 billion (5,2 billion GBP) with a projected completion date in 2035.

## 2.2 Urban challenges and opportunities for design

### **Barriers to design**

A weak governance structure and un-coordinated implementation create the largest barriers to move Metro Manila from engineering-led flood protection to urban design-led flood adaptation. Metro Manila's drainage plans and maintenance operations alone are split over various agencies. The national Department of Public Works and Highways is responsible for the design and construction of the city's flood protection plan, while the Metro Manila Development Agency oversees the implementation and maintenance of the system. This however proves to be a complicated task, with Metro Manila being divided into seventeen autonomous local government units, and two private companies, Manila Water and Maynilad, providing the city's water and water services that lead to overlapping responsibilities and gaps in the co-ordination of flood protection. The conflict between metropolitan and local prioritisation is rooted in the fact that mayors of the local government units are voted in through popular election, while the Chairperson of the MMDA is appointed through the presidency. The local respective constituencies therefore become the first and foremost responsibility and issues at the metropolitan level become secondary (von Einsiedel 1992). Within this current arrangement, the city's ability to address flood adaptation, and interrelated issues such as urban planning and garbage disposal, on a regional level is severely compromised.

In addition to weak governance structure, the lack of sustained funding for large-scale projects has halted the implementation of coherent master plans in the past (Alcazaren 2014, interview 31

July). Daniel Burnham's plans for a water-centric city in 1905 or the Metro Manila 1970 development plans for flood control were never seriously pursued due to problems of economic growth and the failure of the government to acquire the necessary land. Manila's urbanisation pattern today is dictated by market-led development that pays no attention to historic references. Civic resources lacking, and with no centralised body enforcing controlled urban planning, indiscriminate commercial and residential development become major barriers to formulate coherent government-led initiatives. This raises the question of whether the cost for the city's current flood management plan at P351 billion (5,2 billion GBP) can be sustained until projected completion by 2035. By far the most ambitious and expensive flood control programme delivered by the national government, critics of the scheme question whether the infrastructural plans are cost-effective and whether civic resources will be able to sustain the long-term expenses of the proposals.

A further concern is the increase in population and level of urban development that play a major role in lowering the capacity of the city's drainage system and natural water ways - the rivers, canals and *esteros* (tributaries). Over the last half century, Metro Manila's population has risen from 2.5 million in 1960 to 11.8 million in 2010 (Philippine Statistics Agency 2015), and is projected to increase to 13,740,300 by 2035 (World Bank 2012). This level of urbanisation increases the impermeable surface area, and the need for existing drainage systems to be upgraded. Commercial and industrial development, as well as informal settlements encroaching along the city's waterways, create higher levels of flood exposure and have contributed to the siltation of the city's water arteries. Related to this is the accumulation of garbage, and it is estimated that 55 to 157 tons of solid waste is thrown into the waterways on a daily basis, clogging the drainage canals and posing a risk to health and greatly increasing the risk of flooding (Bankoff 2003).

### **Large and small-scale opportunities in Manila**

In order to move toward more ecologically informed practices, the city requires 'change agents' (Brown and Clarke 2009) who work with representatives from the government, academia, land development sectors and the local community toward clear targets. These can be individual actors or stakeholder groups who work on the behalf of the city or a neighbourhood to lead on small or larger-scale change.

One example of local architects who have started to make a case for flood adaptation is the practice of Palafox Associates. Led by Felino A. Palafox Jr., the practice has emerged as a key player in advocating for coherent and sustainable city master planning, and in a position to directly

work with key decision-makers. The practice makes use of historical references as tools for negotiation. The 1905 Burnham master plan and the 1970s Manila Metro Plan, for example, formed the basis of recommendations presented to the Office of the President following the Manila flood disaster in 2009. These recommended a complete redevelopment of the estero system (local tributaries) to improve the connections between the city's Pasig River, the lake and bay front and include the widening and dredging of existing canals. According to the Burnham Plan, this dredging would 'diminish the danger of overflow' and become an 'economical vehicle for the transaction of public business' (Palafox 2014, interview 23 July). Palafox' letter further suggested how the 2035 flood protection plan could be broken down into immediate, short, mid-term and long-term phases to deal with flooding in an integrated, ecological and socially just way.

To build a wider awareness of flood adaptive practice, Felino Palafox is also involved in the discourse across professional and academic organisations, and the national media. Work with the Philippine Institute of Environmental Planners provides support from a professional body of urban, environmental and infrastructural planners, as well as an academic link with the University of the Philippines, the largest academic institution in the country. Widespread media attention on environmentally conscious design has also helped the practice to work with some of the country's most established developers, those open to testing new forms of flood management in large-scale developments. This has led to the implementation of a five-story storm water catchment pool beneath Metro Manila's latest large-scale development and has caught the attention of the government to possibly adapt such practice for the city's current development plans.

Palafox Associates have also been commissioned by the local government of San Juan City to address the district's susceptibility to flooding, for which the practice has proposed the establishment of three circulation levels: street, elevated walkways, and links to the raised public transportation system of Manila. The plans are currently in discussion with a progressive mayor and the local council, and could become a model development for the rest of Metro Manila.

Another example of a local 'change agent' is the Pasig River Rehabilitation Commission (PPRC) that was set up in 1999. The commission was given the mandate oversee the large-scale and ambitious redevelopment project of the city's 27 kilometre river edge, and 4 major and 43 minor tributaries. Some improvements were made, including relocation programmes for informal settlers, the cleaning up of two key tributaries, and the reimplementation of a transport river ferry. The project has also allowed for local solutions to be tested, for example, the development of 'coconet', a weave of coconut fibre to protect river edges from erosion, and 'mapecon'

technology, which harvests the river's ubiquitous water hyacinth for biofuel. These two examples of local adaptation practice have the potential to be applied systematically and to attract local and external funding opportunities, to sustain the efforts to rehabilitate the river.

The commission also appointed architects to draw up plans for interconnected, walkable, bike-able, safe and clean river edges, which due to the complexity of the environmental and urban challenge of the rehabilitation project, still have not materialised. Ten years after the PPRC was established, the focus shifted from addressing the scale of the river to making to smaller-scale improvements to the Pasig's 48 tributaries, with the first clean-up completed project of the 3-kilometer Estero de Paco now serving as a role model for other tributaries (Valmero 2016). The success of this phased improvement programme shares two important factors: firstly, it benefitted from a project champion, Regina Lopez, who in her role as chair of the PPRC was able to co-ordinate between multiple stakeholders. Secondly, scaling down from the river scale to the small scale, which allowed the project to be conducted at a manageable neighbourhood scale and explore the potential for innovative design.

### **Opportunities for developing cities**

While the risk of flooding poses a serious threat, water simultaneously needs to be managed as a resource and a necessity. It could be argued that developing cities like Manila have the potential to experiment and innovate types of flood management that grow out the constraints of their particular context (Djordjevic 2013). This would allow for the integration of different disciplinary insights and sectoral concerns, and frame the protection from, and the access to, water as a public amenity – even if currently unsuitable conditions for integrated planning and a lack of political will for co-ordinated implementation limit the scope for strategic design intervention. Two types of *tactical* interventions could drive a water-integrated design agenda forward, however. First, urbanists and architects can challenge and inform current flood protection practice on a decision-making level; second, urbanists and architects can contribute toward innovative demonstration projects at a neighbourhood scale.

The design methodology in the next chapter responds to the strategic moves developed by Palafox Associates as well as the smaller-scale neighbourhood intervention plans shown in the example of river tributary rehabilitation project. The design proposal presents the opportunity to critique some of the existing water management and urban design practices and to develop a more coherent and integrated framework for potential flood adaptation.



*Figure 2-9 Image of engineering-led flood management, pumping station, Binondo, 2015*





*Figure 2-10 Image of local environmentally-led waterway rehabilitation, Estero de Paco, 2015*

YEAR 1: RESEARCH INTO DESIGN	1. Research into Design provides a method to identify opportunities and barriers for design. It does this via a case study analysis of contemporary approaches toward flood adaptation. This establishes firstly guidelines for design, secondly a framework for exchange of design knowledge and thirdly widens the scope of practice.
YEAR 2: RESEARCH THROUGH DESIGN	2. Research through Design uses a method of interpretation to simulate design. The insights from the case study analysis are translated into the specific context of Manila to produce potential design strategies.
YEAR 3: RESEARCH FOR DESIGN	3. Research for Design is a method of knowledge exchange in which insights of the simulated design are tested, expanded on to inform design practice within the context of Manila. These finding furthermore provide insight to architectural design practice that can be applied to other rapidly urbanised regions in the world.

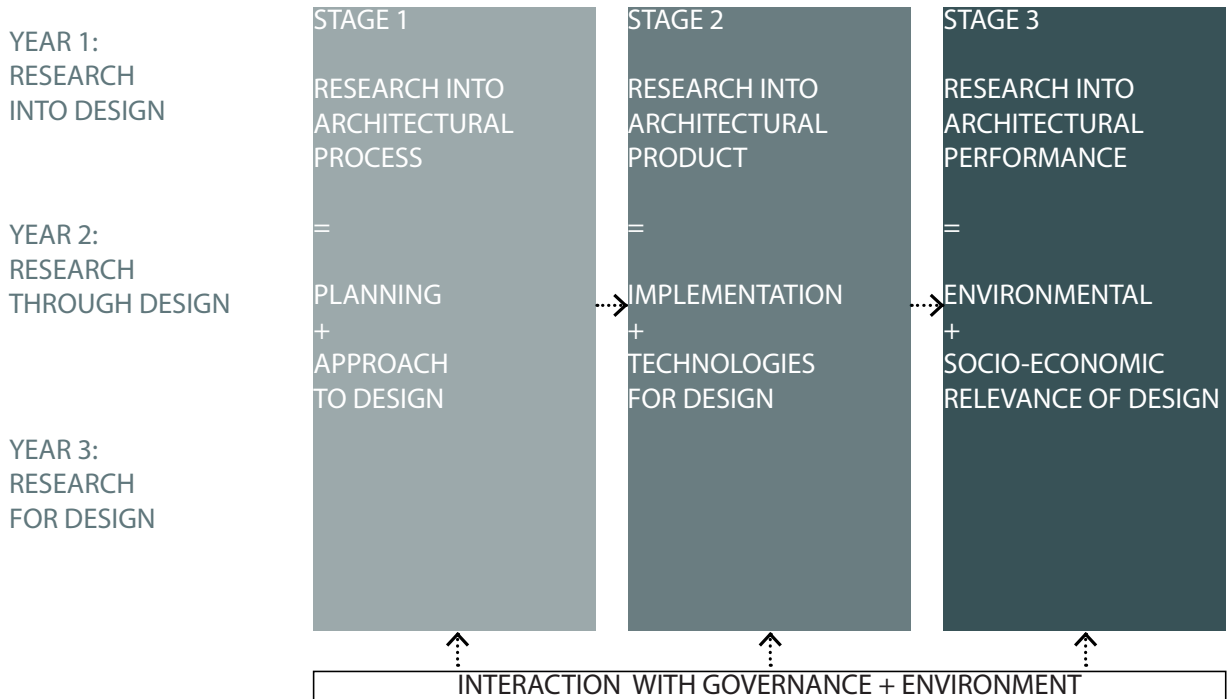


Figure 3-1 Interpretation of research by design models by Frayling, 1993 (top) Till, 2007 (bottom)

## Chapter 3: Framing Design as Research

Two central questions frame the research methodology developed for this study: what is the potential role of architectural design in the environmental adaptation of flood-prone cities, and what role does the architect take in this process? These questions challenge the architect to think beyond the physical manifestation of design and to engage with the interdisciplinary planning and decision-making processes that inform flood adaptation, and identify opportunities for innovative architectural practices. Within the context of flood adaptation, the thesis identifies a range of factors that shape the complex relationships between architecture, environmental context and political governance. These required an interdisciplinary approach, and needed to engage with forms of design research that could enter into a critical exchange with modes of research from other disciplines.

This thesis takes as a starting point that architectural design is a form of knowledge that can be developed through research (Till 2007). As a large proportion of the research was conducted by practice, or more specifically by architectural and urban design practice, it made use of the knowledge base and procedures that are particular to the discipline of architecture. The range of tools for interrogation included precedent analysis, concept diagrams, design drawings and hypothesising about user occupation. These forms of design research ran in parallel with other established modes of research (literature review, historical research, interviews, field studies) and it was the interactive relationship between these research methods that drove the investigation. Relating architectural research to flood risk and political governance requires a methodology that is able to generate new insight and knowledge for interaction between traditionally separate disciplines. The multi-faceted nature of design made it an appropriate instrument to bring together the knowledge from such different perspectives, synthesising within a spatial matrix.

Research models developed specifically for design disciplines were used to inform the methodology. Christopher Frayling's essay 'Research in Art and Design' (1993) and Jeremy Till's model for architectural research (2008) were adapted to shape the overall enquiry. The research process in these models avoids 'the science/art and qualitative/quantitative splits and allows interdisciplinary research' (Till 2007, p.5).



The methodology adopts Frayling's model of three types of design research – into, for and through architectural practice. Frayling describes research 'into' as research into a variety of existing and theoretical perspectives into design. Research 'through' design refers to the step-by-step experimentation and development of the design work, while research 'for' refers to the end product as an artefact, where the research is 'embodied in the artefact' (Frayling 1993, p.5) The first year of my research *into* design considered flood adaptation from contemporary socio-economic, political, cultural and technical perspectives in order to understand existing best practice design principles. This knowledge formed the basis for the second year in which research *through* design developed potential strategies for design approaches, technologies and models of practice that could be applied to the context of Manila. In the final year, the research *for* design was tested and understood as an end product, with architectural design and production part of the research methodology itself. These three methods of design research – into, through and for – provided insights into the roles of design and the designer in flood adaptation, with the insights derived from one research phase informing the next.

The three phases of research were refined further through Jeremy Till's model of architectural research, which distinguishes between research into three stages: process, products, and performance of architecture. Research into each of these can provide insight into the 'processes' that guide and inform a design, the 'products' and technologies used to implement a design, and lastly the environmental, social and cultural 'performance' of a completed design. According to Till, this model of research allows for thematic investigations to emerge, therefore making it possible for other disciplines and methods to inform the research into any of these stages. Furthermore, the model allows design to be considered over time. These three stages are closely interlinked and form 'an iterative loop in which one stage is informed by another' (Till 2007, p.5).

The advantage of using these forms of design research for this investigation is two-fold: Its interdisciplinary nature allows for engineers and urban planners, academics and politicians to contribute to the process of investigation. The temporal description allows us to understand the critical links between successful planning, implementation and sustainable performance of design-led flood adaptation. As Till argues, for 'research to be most effective, and thus for architectural knowledge to develop, it has to feed this loop' (Till 2007, p.5-6).

Together the Frayling and Till models for design research enabled a bespoke research methodology for the practice dimension of the thesis:

• **Year 1: Research into Design – Theoretical and Practical Perspectives**

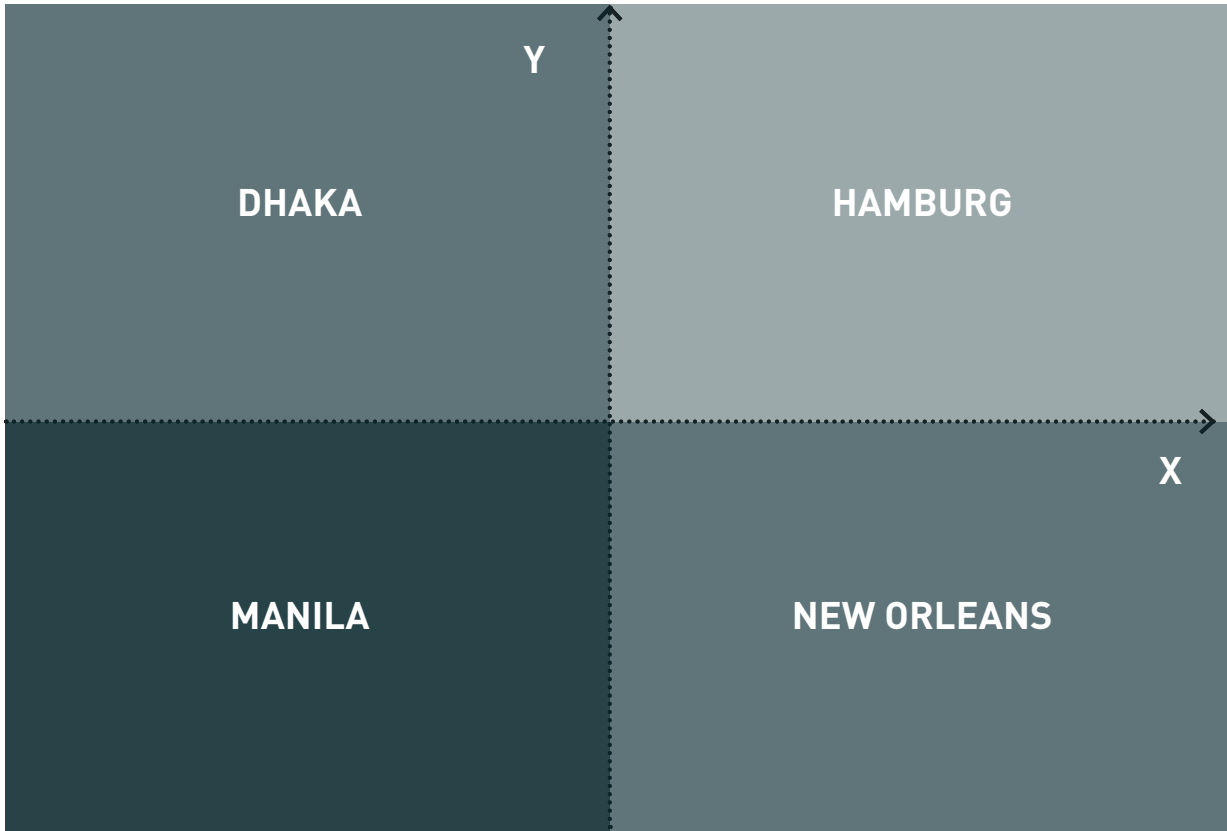
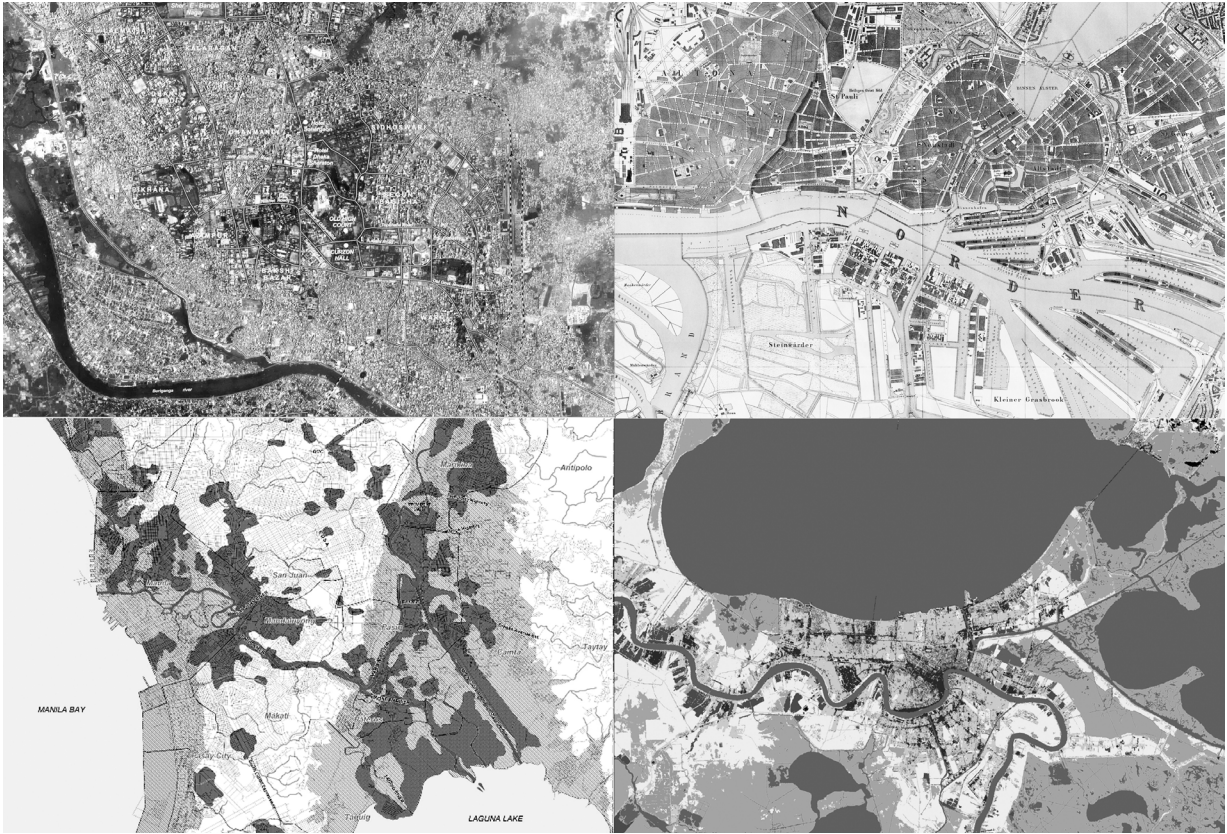
The year firstly looked into the theoretical perspective of Ecological Urbanism in order to build a conceptual framework for designing in at flood risk cities. In parallel, research into case study cities provided practical insights for the research, and identified opportunities for and barriers to design. It did this through an analysis of contemporary approaches toward flood adaptation using three case study cities: Hamburg, New Orleans, Dhaka that Manila could learn from. This analysis produced an understanding of a range of approaches and technologies that could be applied for flood adaptation.

• **Year 2: Research through Design – Strategies and Tactics for Design**

Theoretical readings on ecological urbanism and the data from the case studies were interpreted to develop design guidelines for flood adaption. First, ecological strategies, informed by the literature review on ecological urbanism, were established to guide design intervention. Second, tactical design components were developed that could respond to the particular context of Manila. A water adaptation catalogue exemplifying 'grey', 'green' and 'soft' approaches (refer to multidisciplinary approaches, p.27), was developed in conjunction with a catalogue of spatial components – 'surface', 'building', 'connector' typologies that could be considered for flood adaptation.

• **Year 3: Research for Design – Design Testing and Speculations**

The act of design is a method of learning by doing. Design proposals were tested and the results were used to reflect on the design strategies and tactics established earlier in the study. The proposals reflect the choice of strategies and tactics applied to Manila are reflected on in terms of their environmental performance and potential urban benefits. The findings from this iterative process provided insight into designs and practice that could be transferred to other flood-prone cities facing similar design challenges.



Factors  
X = Environmental awareness  
Y = Ability to invest

Figure 3-2 Matrix of four case study cities according to environmental awareness and ability to invest into flood-adaptation

### 3.1 Year 1: Research 'into' (existing) design and analysis

#### 3.1.1 Comparative study of four cities

A comparative study of four cities at flood risk provided an opportunity to study the role of design in relation to their respective systems of flood management. The cities of Hamburg, New Orleans, Dhaka and Manila have been experiencing increasing flood problems in recent years and committed to address their respective flood protection plans. A recent study conducted by the Organisation for Economic Co-operation and Development (Nicholls et al. 2008) looked at 136 of the world's large port cities and established their level of exposure to coastal flooding due to sea level rises and storm surges in 2005 and 2070. Rankings were produced on the basis of physical exposure and socio-economic vulnerability, and assessed population and assets as the two main indicators of exposure to flooding. Among industrialised nations the report lists New Orleans currently as an example for high population and asset exposure, and Hamburg as an example for a city with a much higher level of flood protection, reflecting the local and national authorities greater will and capacity to reduce and/or counter flood hazard risk. By 2070, the increase in asset exposure will shift to the rapidly growing cities in developing countries (Hanson and Nicholls 2011) due to population and socio/economic growth, and urbanisation. A separate report on Climate Change and Environmental Risk (2013) by global risk analytics, research and strategic forecasting company Maplecroft, lists Dhaka and Manila as two cities at most risk from changing weather systems that are forecast to take hold in the coming years (Maplecroft 2013). While Dhaka has started to address its flood concerns since 1989, Manila only undertook a yearlong flood risk assessment study in February 2011, in response to severe flooding in the fall of 2009, and represents a developing city with a slow response to the need for flood management.

The comparative study examined a range of factors that influence a city's ability to adapt to flooding, including its awareness of flood design practice, the provision of institutional support and the capacity to invest. It also revealed the extent to which design-led flood adaptation is or isn't used in cities with differing capacities. The aim was to identify best practice approaches, which in the future could inform design practice in different local contexts and potentially in different cities.

### 3.1.2 Analysis of design practices

The horizontal axis of the matrix was divided into low economic investment on the left and high economic investment on the right; the vertical axis was arranged by poor governance structure on the bottom to good on the top. The combinations of the two variables represented four specific types of adaptive capacity in relation to flood protection. These case studies were qualitatively assessed in terms of the environmental and socio-cultural performance of their respective flood management measures. The mapping across four cities enabled a systematic evaluation of current flood adaptation practices.

The four approaches to flood management helped to construct a ‘possibility space’ (Berkhout and Hertin 2002) that could be explored within the context of Manila. The investigation relied on Grounded Theory, sampling both primary and secondary qualitative data, including literature, reports, films and engagement with focus group discussions. Primary data for Hamburg and Manila were collected through interviews and site visits conducted June – August 2014. The secondary data used for this thesis was collected through qualitative methods. The case studies on Hamburg, New Orleans and Dhaka are comprised of empirical data from textual analysis to examine the cities’ particular governance structure, financial capacities, understanding of risk, and the implications for design.

The unprejudiced, open-ended and iterative process of the case study analysis informed a process of ‘coding’ of Manila’s urban characteristics and ‘memo-ing’ of flood adaptation concepts that could be in a later step be integrated into the design proposal.

To compare the findings across all cities, a SWOT analysis (Strengths, Weaknesses, Opportunities, Threats) was conducted. This method allowed the examination of the amount and quality of design of each of the city’s flood planning strategy to evaluate the strength and weaknesses of current plans and implementations as below:

Step 1	City risk assessment – Type of Flood Hazards/Vulnerable Exposure/Adaptive Capacity
Step 2	Planning of flood management – Institutional Setting/Financial Capacity/Coherent Planning
Step 3	Implementation of flood management – Adaptability/Multiplicity/Sustainability
Step 4	Identification of design application and role of design – if any
Step 5	Transferability of design practice and role of design to this research study of Manila

The first step of the case study analysis provided an overview of the city flood typology by considering natural or man-made flood causes. In the following two steps the qualitative assessment looked at how effective flood management is planned and implemented as part of the long-term development plans for the city. The analysis of the planning stage examined the level of integrated decision-making, cross-disciplinary development and financing of the flood adaptation programme.

For the analysis of the implementation stage, the study evaluated three factors: the physical adaptability of the design to the presence of water, the programmatic multiplicity of the design to allow for urban occupation, and the sustainability of the design strategy to guarantee long-term flood protection and urban value (Stalenberg 2011). Each city's specific institutional and economic arrangements provided insight into opportunities for and barriers to cities moving from conventional flood management strategies to more adaptive models.

The final two steps examined at which point in the design process architectural planning and design were applied to address flood risk – if they were. The particularities of each case study were extracted and translated into universal design approaches and technologies that could be considered for the design study of Manila.

The guiding design principles and conceptual framework for the practice phase of the thesis emerged from the study of the role of design and the designer across the four case studies. This contributed to the development of design scenarios for particular flood prone areas in Metro Manila. Potential scenarios were produced at various scales and from different disciplinary angles in order to formulate design recommendations for the decision-making, planning, implementation and maintenance stages.





Factors  
A+B = Urban Grain  
Z = Projected development over time

Figure 3-3 Comparative test sites according to urban grain and potential for future urban development

### 3.2 Year 2: Research ‘through’ design and interpretation

Research through design built on the knowledge gained from Year One’s four-city analysis and explored how design-led flood adaptation could be applied to the particular context of Manila. This exploration identified what types of barriers and opportunities exist for flood adaptive design on specific sites in Manila and, more importantly, whether these could inform guidelines for particular design strategies and tactics. This in turn suggested the kind of role the architect may need to take to implement designs at a neighbourhood scale.

Shifting the focus from research *into* to research *through* architectural and urban design meant a shift from design observation to design development, with useful idea from the analysis transferred to help in the design development for Manila. Development took two forms:

1. **Strategic design process:** The development of incremental architectural interventions was intended to complement the city’s on-going engineering-led flood management plans, which currently lack architectural and urban design focus.
2. **Tactical design proposals:** A water-sensitive design approach at a neighbourhood scale, involving an investigation of urban typologies, local materials and building technologies that could be applied to the local urban context. The scale of the design proposals fill a gap between the current engineering-led flood management master plan and small-scale flood adaptation projects in Manila (see Chapter 2 – Large and small-scale opportunities in Manila)

#### 3.2.1 Defining test sites

For the Manila case study fieldwork was conducted in July and November 2014 and again in October 2015, with semi-structured interviews held with actors involved in flood management and urban planning, including city and national government officials, academics and design professionals. Primary and secondary sources were analysed including city flood hazard maps, flood engineering reports, academic literature, on site photography and websites.



The city's main water artery, the River Pasig and its flood-prone edges, was central to the investigation. Stretching for 25 kilometres through four of the capital's 17 independent chartered cities, the river poses a range of flood risks and governance challenges. The reopening of Manila's only water-based transportation, the Pasig River Ferry Service, in April 2014 suggests the potential for local investment in public infrastructure around ferryboat stations with an expansion of a river-wide network in the near future. For the purposes of the research project the boat stations were used as starting points for the location of sites of intervention.

The sites were chosen according to spatial and economic criteria: the potential for environmental adaptation in relation to existing urban fabric, and the potential for future investment depending on the site's relation and proximity to neighbouring districts and centres. From eleven ferry boat stations, two were picked for their contrasting locations and for the different challenges presented in terms of stakeholdership and spatial conditions. In addition, a third site was chosen that was not connected to the ferry boat network (but located on the opposite side of the river to site B).

- **Site A – Escolta Station** represents a heritage site, which required carefully retrofitted flood adaptation. The site could potentially be developed in parallel with the facing Plaza Mexico Station, located next to the older historic core of the city.
- **Site B – Santa Ana Station** represents a mixed-use site that is targeted for future transformative urban development. The site is connected to the city's financial centre to the south and faces an informal settlement to the north.
- **Site C – Punta** represents an informal settlement site that currently lacks a flood protection strategy. The site could act as a prototypical development for slum upgrading projects that are currently being considered by the city.

The historic value of Test Site A, transitional character of Test Site B and the informal nature of Test Site C presented different design challenges. While they required different site-specific interventions, these sat within an overarching strategic framework: the incremental reorientation of the city towards the river and the generation of new ecological and economic infrastructures for Manila.

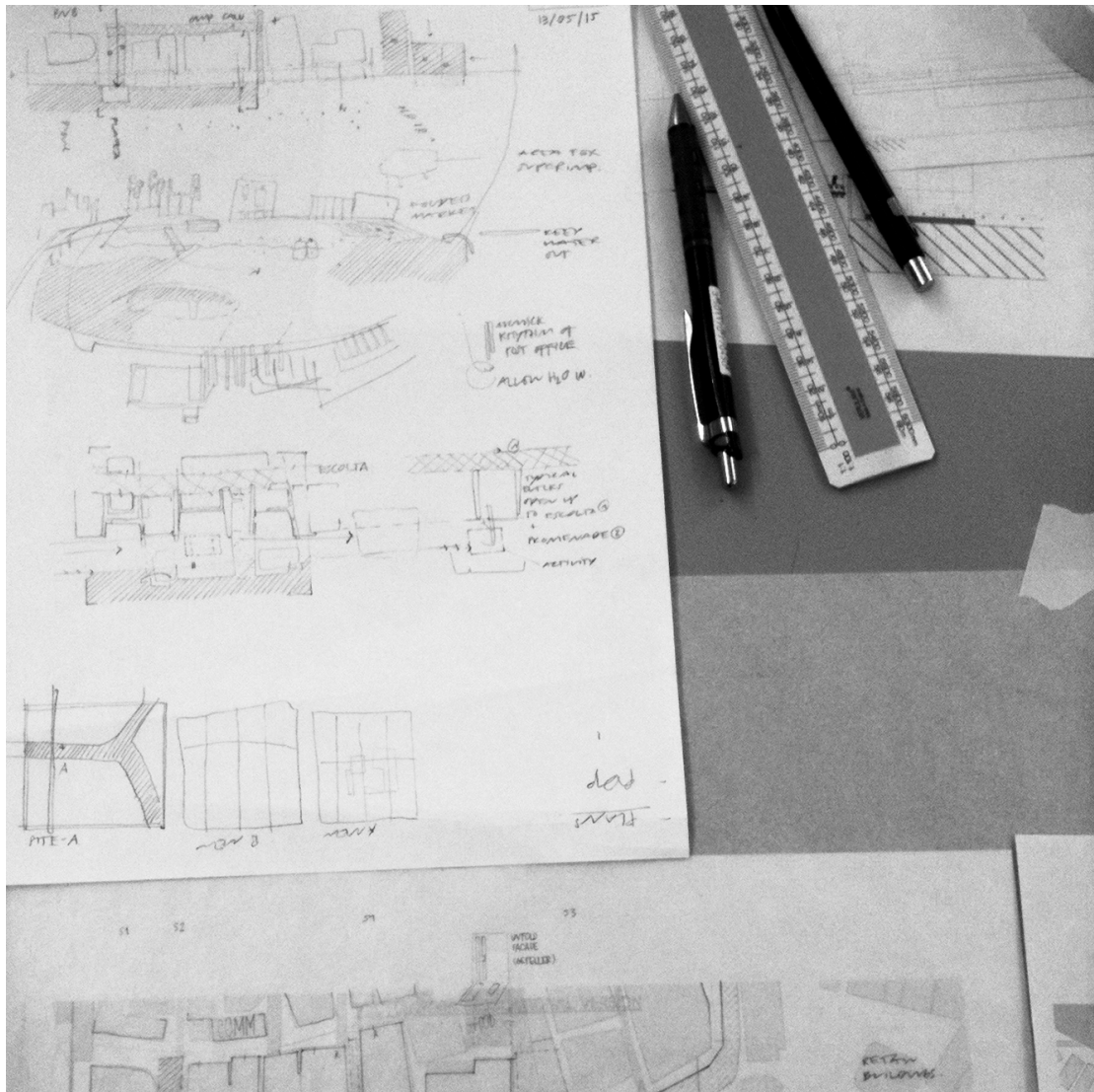


Figure 3-4 Early design sketches

### 3.2.2 Drawings as tools for analysis, interpretation and reflection

The cataloguing of design approaches, design technologies and modes of practice through the case study analysis in Year 1 provided a critical lens with which to analyse the Manila sites and identify design opportunities as well as barriers. The sites were read not only in spatial terms, but in environmental, socio-economic and cultural terms as well. As a starting point, the area of examination was limited to the site of the river ferry station and the edge of the riverbank. An initial catchment radius of 400m around the station was used to analyse reasonable walking distances to points of interests or transportation networks, with allowance made for this radius to be expanded after the proposed interventions along the riverbanks. From a temporal perspective, the sites were viewed within a timeframe of less than 20 years - until 2035 and the projected completion of Metro Manila's engineering-led flood protection.

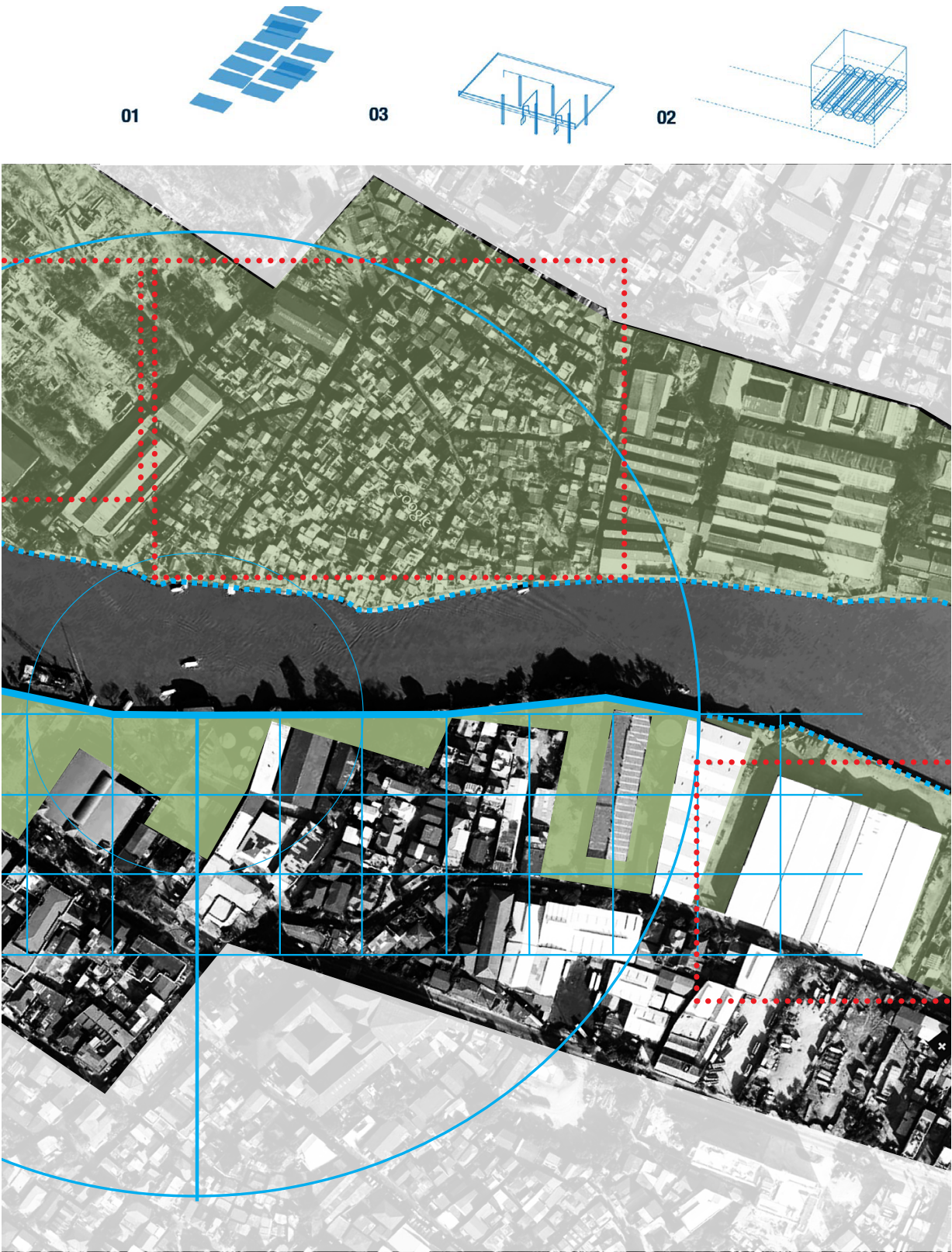


Figure 3-5 Testing and development of design strategies and tactical interventions in Santa Ana

### 3.3 Year 3: Research 'for' design and application

In Year 3, the method of enquiry moved to from research through to research for design. This stage of investigation borrowed from the operational practices found in ecological urbanism, a portfolio of landscape and urban design techniques. Methods of diagramming, zoning and planning from urban design were combined with mapping, layering and phasing procedures from landscape design in order to widen the range of techniques. (McHarg 1969, Corner 1999) As visual methods of enquiry, these helped to represent, generate and test design propositions.

Ecological urbanism presented itself as a suitable strategic model for three principle reasons (Corner 2003): first, it has developed specific mapping tools to address the complexities of any given site. Second, it enables the construction of design frameworks that relate across scales (regional to site) and disciplines. And third, it works with open-ended and flexible notions of time, which allow design proposals to be viewed as a staging in specific conditions rather than as fixed and finished projects.

1. The mapping of the specific conditions of the case study sites was based on the collection of visual and textual data, which represent areas of flood risk, demographics, and environmental and urban concerns. These physical, environmental, social and cultural dimensions of the case study sites were represented first through individual layers of drawing, and in a following step, as a series of overlays to visualise the correlation between natural and urban systems. This process of overlaying, established by landscape architect Ian McHarg, was used to identify areas of high to low risk, and to suggest possible urban, landscape and architectural design options (McHarg, 1969).

The information for the mapping exercise was collected and developed through primary source material on Manila's flood management documents obtained from the Department of Public Waterways and Highways and the Metro Manila Development Agency during the fieldwork conducted in July and November 2014. The maps were further developed through interviews conducted in the same period with city and national government officials, academics and design professionals, and cross-checked with on-site photographic surveys. The graphic representation of this data established the scope and limitations for physical design interventions within these test sites.

2. Through a set of geographical notations (Lynch, 1960) crucial 'paths', 'edges', 'nodes' and 'landmarks' for each of the case study 'districts' were identified and contributed to site-specific flood adaptation strategies. The use of this diagrammatic form of visualisation allowed for the dynamic and complex nature of the sites to be simplified (Tufte 1990) in order to construct a coherent framework for particular design interventions. Tested against the individual physical, environmental and social layers, alternative strategic plans were produced.

The catalogue of flood adaptation approaches established in Year 1 further informed the type of strategic approach for each test site in Manila. The specific grain and local conditions of each district suggested first what operational lines of development could be inserted into each site, and second what type of particular design interventions could be applied to particular paths, edges, spaces and landmarks. Using diagrams as a design method produced a visualisation of the interrelation between the physical structure of the site and a new organisational system that was to be superimposed there.

3. Landscape architect James Corner describes this method of mapping as enabling designers to merge the technical concerns of a site with layers of cultural and formal concerns. The 'staged ground' anticipates gradual to extreme forms of change, as ecological urbanism works within ideas of flux, movement and temporality. The thesis designs, therefore, had to be able to shift and adapt to change over time.

In order to move from design analysis to design proposition, creative and constructive drawings were used to inform and generate new research. This mode of research *for* design enabled both the analysis of the sites' challenges and the articulation of particular conditions (Lawson 1997). For example, in order to arrive at the choice of sites, drawing was used to analyse the urban grain in relation to flood risk, programme and connection to other urban centres. Drawing also enabled the sites to be considered at different scales and from different viewpoints (in plan, section and three-dimensional representation).

The mode of drawing therefore became a form of testing of the sites with hypothetical interventions that were informed by earlier guiding principles developed from Year 1. It established a form of simulation (Groat and Wang 2013) that aimed to capture the complexity of the site readings and test the implications of spatial interventions over time. Layering of the drawing allowed for the interplay between a range of variables and considerations that may affect the design. As Lawson points out, drawings allow to 'keep in mind and consider so many disparate factors' (Lawson 2004, p.52). The process of drawing *per se* however, does not



present a controlled method of research. For drawings to work as a research tool, Lawson lists two conditions. The drawing first should focus only on answering questions that are asked at the time of research, and second the precision of the drawing produced should reflect the level of clarity 'in the designer's mind at the time' (Lawson 1997, p.242).

While the act of drawing arrests ideas for examination, as a creative thought process it mediates between reflecting and recombining ideas to produce new ones (Robbins 1997). These points of reflection are necessary to maintain rigour and significance, as well as to be able to identify original insights. Personal and interpersonal forms of reflection were established for the drawing process to encourage and record critical reflection: the first, a design diary and the second, interaction with fellow professionals.

The design interventions for the sites along the Pasig can be read as a system of incremental ecological intensification (Hagan 2015) that is laid out on the edges of the river and then proliferates inland through the development of new nodes, landmarks and paths within the district. The flood adaptation catalogue developed in Year 1 was interrogated to see how a range of existing small-to-medium scale water management tools could be appropriated to suit the local conditions of Manila and act as potential environmental and socio-economic catalysts. As a temporal strategy, therefore, the design interventions are dynamic and can expand as socio-economic resources permit. As a strategy, it is spatially, programmatically and logistically able to adapt in response to changing circumstances. The proposals that emerged from this study are not to be regarded as explicit design solutions to the city's flood risk, but rather should read as an illustration of a process to analyse, inform, test and frame design approaches and principles that respond to the particular challenges of Manila.

The Ecological Urbanism strategies and tactics developed for the design proposal were discussed with external practitioners with particular knowledge of flood adaptation. Discussions in the period of February – May 2016 were held with engineers from the University of Portsmouth and UCL's engineering department to inform quantitative studies on water harvesting and retention systems. In the same period architectural, urban and landscape design strategies were developed in discussion with landscape designers from Queen Mary's University and urban planners from the UCL. The design drawings were used to test how the design of new ecological systems could meet the requirements set out by the specialists. The method of researching into, through, and for design therefore became a means of understanding how, and also how not to, adapt to flood risks in Manila and other flood-prone cities.

# DHAKA

# MANILA

*Figure 4-1 Satellite view of four case study cities*

An aerial photograph showing a wide, winding river flowing through a flat, agricultural landscape. The river is dark and meanders from the top left towards the right side of the frame. The surrounding land is a patchwork of fields and some small clusters of buildings.

# HAMBURG

An aerial photograph of a coastal city, likely New Orleans, showing the Mississippi River Gulf Outlet. The river is a prominent, winding feature in the foreground, flowing from the bottom left towards the center. The city is built along the river and the coast, with various industrial and residential areas visible. The Gulf of Mexico is to the right.

# NEW ORLEANS





Figure 4-2 Images of flood events: Dhaka, 1989, New Orleans, 2005, Hamburg 1962

## Chapter 4: Case Study Cities

The transition of a city toward flood-adaptation is ‘partly a matter of learning by doing’ (Aerts et al. 2011). In a study on ‘Waterfront Adaptations to Extreme Flood Events’, Kristina Hill (2011) notes how cities that in recent history have experienced significant flood events have developed specific strategies to adapt to increasing flood risk. The three cases Dhaka, New Orleans and Hamburg are examples of cities that in recent years have developed different flood management measures. They represent cities different capacities to plan, invest and co-ordinate effective flood strategies. Dhaka represents a city with high awareness to flood risk, but low ability to invest, New Orleans a city with low awareness and high ability to invest, and Hamburg a city that has both a high awareness and capacity to invest into flood risk. The aim of the comparative analysis is to learn from best and worst practice examples, and to draw what limitations but also what possibilities there might be for design-led flood adaptation.

The chapter is divided into the three case studies, which is followed by a summary of flood management approaches and technologies the three cities are developing. It focuses on identifying each city’s general flood management and potential design principles (if any) that may be considered to develop design-led flood adaptation plans for Manila. The chapter begins with the discussion of Dhaka’s large-scale engineering plans versus small-scale coping strategies. New Orleans is considered in terms of the role of local design practices are establishing to challenge the city’s infrastructure-reliant flood protection. The case study of Hamburg explores how a mixture of economic incentives and design-led urban planning can inform innovative forms of flood adaptation. The comparative analysis is used to draw general design principles that may be relevant for the plans for flood-adaptation in Manila.

It will conclude with observations on the role of design across the three case studies and initial recommendations for the transfer of best design practice for this design project. The development of short-lived and often conflicting master plans of Manila over the last century reflects the city’s lack of vision, weak governance and capacity to invest into long-term planning. With present split jurisdictions creating strong differences in environmental governance between the municipalities within the wider metropolitan area, (Asian City Green Index 2001, p.21), Manila’s urban planning and development needs to be questioned to begin to establish a comprehensive approach able to cope with the increasing urban and natural challenges in the future.



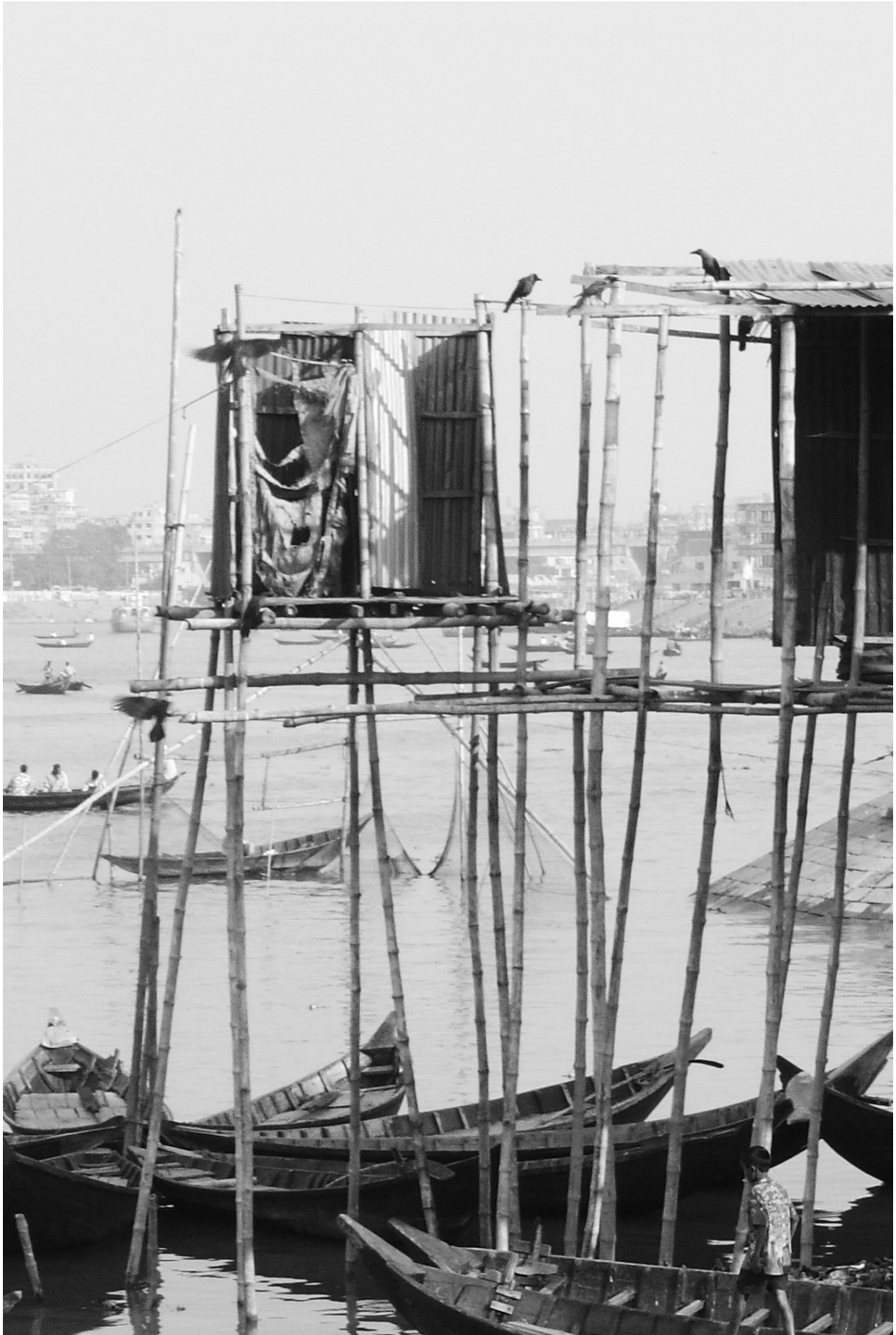


Figure 4-3 Example of coping with water. Stilt house in informal settlement, Korail, Dhaka

#### 4.1 Case Study 1: Dhaka

The cities of Dhaka and Manila are used as representative case studies for flood management in developing countries. The Coastal City Flood Vulnerability Index a recent study developed by a team of scientists from the UK and the Netherlands evaluated the exposure, susceptibility and resilience of nine major cities to coastal flooding (BBC 2012). It suggests that Dhaka and Manila are the two cities at most risk from changing weather systems that are forecast to take hold in the coming years. The study further concluded that in both cities the 'social vulnerability to coastal flooding will be double [...] by 2100, unless measures to counter the threat are taken' (Balica, Wright and van der Meulen 2011, p.100)

With regard to other flood risks, both cities demonstrate a high level of exposure to riverine flooding and flooding due to high precipitation and insufficient drainage capacity. From an adaptation perspective, Dhaka has been addressing flooding concerns since 1989, and is used as an example of a developing city with a high capacity for institutional change. Following disastrous floods in 1987 and 1988, the city has received support from the World Bank to help in coordinating international efforts toward the implementation of a comprehensive long-term programme for flood control and drainage in Dhaka (Asian Development Bank 2002).

##### **Barriers to flood adaptation in Dhaka**

The flood risk in Dhaka is caused by the rise in water level of the network of rivers that surround the city. The city has been experiencing periodic flooding historically, but other factors are increasing the risk of flooding: Dhaka's speed of urbanisation, the congestion of the internal drainage network and a lack of coordination in the regulation of flood management systems. The rate of recovery for the city is very slow due to the 'high number of days needed to recover after a flood event and small kilometres of drainage' (Balica, Wright and van der Meulen 2012, p. 22). The city's Flood Action Plan of 1989 engineered flood defences developed in response to the floods in 1988, which placed 80% of the city under water. This consists of a combination of embankment and floodwall controls, as well as a system of storm sewers and pumping stations (Huq and Alam 2003). Despite improvements in the city's flood protection, a flood in 1998 affected the entire east of the city, while 20% of the western district was flooded due to hydraulic leaks and uncoordinated operations of floodgates. Similar flood impacts on the city were recorded in 2004.

A study of long-term mitigation strategies for Dhaka city found that the city's drainage capacity is inadequate, and worsened by the encroachment of development into existing flood retention areas. Leakage occurred in floodwalls, which were either incomplete or intentionally removed by people for easier passage. Lastly, there is a lack of inter-agency coordination as a result of a fragmented institutional structure, with different organisations responsible for the flood protection, drainage and operation of the pumping stations.

The study recommends flood adaptation through careful planning. West Dhaka is already developed and the strategy here is to protect the existing lakes and canal systems from encroaching development (Huq and Alam 2003). East Dhaka has the additional complication of weak governance. A natural floodplain, East Dhaka's flood risk has increased with rapid urbanisation that remains uncontrolled by the city planning authorities. From a planning point of view, areas would need to be protected to serve as retention ponds to prevent ponding in the future. The study points to the financial consequences, stating that 'unless these areas are identified and preserved now, these will be taken up by urban developers and the city authority may have to buy these areas back at a much higher price compared to their present value' (Faisal et al 1999, p. 97)

### **Opportunities in Dhaka**

A review of the Bangladesh Flood Action Plan provides a strong argument for the application of adaptive flood management principles (Sklar 1992). The paper questions the cost effectiveness of engineered flood control and the ability of the structural measures to effectively reduce risk of danger to human life and damage to property. The author recommends instead the approach to flood management using a variety of non-structural measures such as flood forecasting and warning, flood preparedness, flood proofing and enhancing traditional adaptations the country has already developed. The last three points of preparedness, proofing and enhancing traditional measures are of interest for possible design interventions in Manila.

Within rural Bangladesh, people have already developed systems of platforms or rafts that can respond to flooding (Sklar 1992). The agricultural sector has also adapted, farming on floating rafts and developing crops that are flood-tolerant. Within cities, coping strategies could also be developed into more adaptive forms of occupation. Floodwalls could be developed for individual buildings rather than building urban floodwalls, which require regulation and maintenance. A study by the UCL's Development Planning Unit (Jabeen, Allen,

Johnson 2009) also suggests how slum dwellings have reconfigured via pulleys to lift valuables onto raised levels to avoid flood damage. These studies suggest how internal knowledge transfer of existing adaptation strategies can be developed via design to form a more diverse set of approaches to Dhaka's flood risk.

An example of external knowledge transfer can be found in the work of Koen Olthuis (2014), founder of the Dutch architectural firm Waterstudio NL, who approaches the challenges of the city at a practical level. As member of the UNESCO Institute for Water Education Flood Resilience Group, a key concern of Olthuis revolves around establishing resilient urban water management. His studio won the 'Architecture & Sea Level Rise' Award in 2012 for their proposal for slum upgrading – an integrated approach to invest in informal neighbourhoods and communities – in Dhaka through the use of floating urban structures housing functions that can be added to a neighbourhood by placing them on water where needed. As flexible structures that can be added to the existing urban grain of the city in response to the communities varying needs. With the award money, Waterstudio NL intends to implement the first City App in the Korail district of Dhaka. In the proposed financial model, companies would finance the structures that local municipalities would lease on a monthly fee. Such multi-disciplinary design approaches enable alternative ways of living with rising sea challenges, and potentially ways of organising urban growth.

A final example of architectural practice offers a stimulating and challenging holistic design approach for Dhaka. Kazi Khaleed Ashraf's 'Designing Dhaka: A Manifesto for a Better City' (2012) provides a critical framework for a flood adaptive type of urbanism. Ashraf's manifesto reflects the position of ecological urbanists, and maintains that by working with its particular geography and hydrology, and its growing urban needs, Dhaka can be a unique green and highly liveable city. This approach is supported by a theoretical starting point that frames the different urban morphologies in relation to Dhaka's connection to water. By making strong use of historical references, it builds up a range of design scenarios within a 'liquid landscape'. The theory is translated into a 15-point manifesto for the city, with realisable possibilities for Dhaka's water edges. These include land use zoning, the development of floodable parkland, the use of water for transportation, and elevated and floating structures. A radical reclamation of Dhaka's Buriganga River and its banks on both sides, he argues, is crucial for an economic cultural reinvigoration of the city. At the core of Ashraf's agenda lies the value of urbanism – the experience of the citizens – and the need for a bold vision to move toward such a water-oriented city.





Figure 4-4 Examples of low cost flood-adaptation. Top: Amphibious house, Prithula Prosun, 2010.  
Bottom: Floating gardens





Figure 4-5 Example of floating building for Korail, Dhaka by Waterstudio.NL, 2012



Figure 4-6 Example of engineering-led flood protection, New Orleans

## 4.2 Case study 2: New Orleans

A recent study on cities and their climate vulnerability conducted by global risk analysts Maplecroft lists New Orleans as a city at high risk. The failings of the levees during the landfall of Hurricane Katrina in August 2005 flooded 80% of New Orleans, with some parts of the city under 4.5m of water. The US Congress in the Flood Control Act established the city's flood protection system in 1965, which gave the U.S. Army Corps of Engineers the mandate for the design and construction of flood protection for the city. At the time it was projected that the floodwalls and levees would be completed within thirteen years. Nearly forty years after the Act was authorised, 60-90% of the Protection Project was completed, and investigations into the federal flood protection system have identified the inadequate design and construction by the Corps of Engineers as the primary cause of the flooding (Nola 2013).

Since Katrina, the U.S. Army Corps of engineers met their self-imposed deadline of June 1, 2011 to upgrade the flood control system with new levees, floodwalls and pumps at a cost of \$14.5 billion (Nola 2013). In response to the US' greatest engineering disaster, the ability to upgrade the flood defences within six years stands in contrast to other international major coastal defence projects, such as the Thames Barrier in the U.K. that typically have a lead-in time of 30 years or more (Hanson and Nicholls 2011). Politically, the flood protection decisions needed to be taken very quickly after Katrina, which explains the reversion to tried and tested engineering-led methods. As an example for a city with high-investment/low flood adaptation awareness, New Orleans' challenge lies in developing adequate long-term provision for climate change and future socio-economic development.

### Long-term considerations

On a macro-scale the wetlands at the mouth of the Mississippi estuary are disappearing. The U.S. Geological Survey suggests that the Louisiana coastline has been losing wetland areas at the rate of 16.57 square miles a year over the past 25 years (Nola 2013). The rapid loss is explained by the subsidence of particular wetland areas, industrial production and sediment deprivation caused by the levee building along the river. With the flood protection being built on different soil types that vary in thickness and compress at different rates, it is difficult to predict whether the reconstructed levees will perform to their designed standards. The U.S. Army Corps of Engineers has already admitted that part of a '1.1 mile long stretch of a levee along the Gulf Intracoastal Waterway has sunk 3 to 6 inches below its design height' (Nola 2013).

The socio-economic longevity of the engineered solutions also requires further scrutiny. The levees have promoted a false sense of protection, and have led to development in flood-risk areas that may again lead to catastrophic losses in the event of future failure (Hanson and Nicholls 2011). Furthermore, once construction is completed, the U.S. Army Corps of Engineers will turn over the operations and maintenance of flood protection to the city officials. According to estimates conducted by the USACE 'Operation, Maintenance, Repair, Replacement and Rehabilitation' costs for the 350 miles of levees, flood walls and associated flood protection structures are anticipated at \$38 million over the next 10 years. It will be a challenge for the city government to raise the funds for the operation and maintenance of the upgraded flood protection. Local authority officials are hoping for Congress to approve proposals for operation and maintenance costs to be shouldered by the corps. This however remains uncertain.

Apart from the significant investment that hard-engineered defences require, the city of New Orleans faces the uncertainty of whether displaced residents will return. The city was already experiencing an out-migration of its middle-class, and its economy was stagnant pre-Katrina. One of the most controversial plans considered post Katrina was the Urban Land Institute's proposal for a selective rebuilding of neighbourhoods based on the extent of hurricane damage. These challenges underline the importance of the active representation of New Orleans' residents in the long-term planning and redevelopment process in order for them to rebuild their communities (Reardon 2015).

### **Barriers to integrated flood management**

In the aftermath of Hurricane Katrina, the immediate need for reconstruction and visible political action reduced the potential for long-term integrated design. Fragmented governance and the lack of a coherent rehabilitation plan have so far prevented the integration of flood protection with place-making, and form the major barriers to design-led approaches to flood adaptation.

New Orleans' fragmented governance is reflected in the historic conflict between city, state and federal officials. It can be argued that the city's barriers to more effective adaptation don't lie in the unavailability of technical knowledge, but in the lack of communication and interaction between stakeholders, as well as the failure to manage the paradigm shift towards long-term systematic planning (Geels 2004, Walker 2000). A multidisciplinary approach, with a clear plan and full participation of stakeholders, is therefore key to enable long-term planning towards successful flood adaptation (Aerts 2011). As a consequence of fragmented governance, the ability to formulate long-term plans is further compromised due to the organisational resistance, lack



of political will, weak community engagement and unsuitable institutional arrangements in the planning stages for flood protection (Brown 2009). Significant economic investments into hard engineering that are likely to be unsustainable are a further weakness of New Orleans' current flood protection system. The split between the federal design and construction of the flood protection and city level operations and maintenance does not allow for explorations of a wider range of adaptation options. In terms of investment for the first phase of construction, the estimated costs were \$738 million, with 70% of the costs being paid by the federal government and the remaining 30% covered through state and local investments. The plans, led by the federal government, acknowledge neither the long-term environmental impact nor the demographics.

With no integrated plan for what New Orleans might aspire to be, initial design efforts towards regenerating the city have remained un-coordinated and mostly reacted to the need to rebuild shelter, rather than to design places for communities. The example of the 'Make It Right Foundation' designing individual prototype showcase houses in the Lower Ninth Ward reflect the lack of an overall coherent urban strategy at a city level. Prior to Katrina, the suburban district developed by the Make It Right Foundation was already badly integrated with the rest of the city. It has also been suggested that the level of suburbanisation and the transportation gridlock leading to the failure of evacuation of parts of New Orleans would be reason to argue for alternative forms of urbanism (Bartling 2008). 'Higher-density land-use, mixed development, accommodation for pedestrians, and multiple modes of transportation' (Bartling 2009, p.108) are some of the strategies that have largely been ignored in the planning process that took place after the floods. Opportunities of this scale require political will and a coherent planning strategy, both, which have been absent in the fragmented governance structures of New Orleans.

### **Opportunities for design**

Alternative ways of conceptualising the city and flood resilience have been developed through feasibility studies by designers. The radical proposal by the architects Morphosis (Mayne 2011) to reverse engineer New Orleans' delta topography looks at the reclamation of areas at highest risk of flooding, so that the repurposing of these low-lying areas into wetland would create a soft defence against floodwater. Part of the strategy would include developing higher density schemes on vacant plots on higher ground and to reverse the typical rural-to-urban form of development. This hypothetical proposal not only considers the ecological gains, but also the economic feasibility. The study suggests that the cost of reclamation and relocation would only be three-quarters of the costs of the current engineered solutions.



Research has also been conducted on the strategic planning of neighbourhoods through participatory workshops. Studies led by Deborah Gans Studio have contributed to the strategic planning of particular neighbourhoods of Plum Orchard and the Ninth Lower Ward in New Orleans (Gans 2011). The proposals that emerged are built from the flexible design and policy strategies that work with existing social conditions and urban typologies. The approach of the studio is to look at the value of the existing urban form and community structures to formulate strategies that have the capacity to be developed from the ground up and have the ability to transform with needs over time. The proposals begin with a careful analysis of the demographics of the low-income populations within the flood-zones to address infrastructural gaps and actively seek socio-economic opportunity through place-making. On a macro-scale, the studies also looked at territorial conflicts, the deadlock political processes that take place in large-scale planning, and the habitual reliance on large infrastructure. The project counters this by starting with work from the ground up, working closely with the actual communities and the existing urban forms that have developed on the flood plains over time.

The third feasibility study is by Waggonner & Ball. In comparison to the two previous studies, the architects have suggested flood adaptation strategies that are currently being considered at decision-making level. They propose to introduce new environmental strategies by bridging the information gap, developing a framework for effective knowledge exchange and moving toward implementation through international collaboration with Dutch water experts. In 2006 the practice led exchange workshops with Dutch engineers, planners, designers, and soil experts, and New Orleans officials. This led to creating an academic platform for flood adaptation in two university programmes, and to their appointment to lead a multi-disciplinary team of designers, practitioners and academics to further develop the work from the 'Dutch Dialogues'.

Waggonner & Balls' proposals work with the current flood protection system, and in parallel set out long-term design-led solutions that reintroduce the 'natural' hydrology back into the city. Plans to create open water storage visible to the city will aid with soil subsidence and floodwater, and on a larger scale will be connected to the existing canal infrastructure of the city. The combined blue-green landscaping strategy is intended to slow down and store storm water and create new public spaces around water (Waggonner & Ball 2014). The practice, which developed the comprehensive Greater New Orleans Urban Water Plan studies in 2010-2012, is seeing through small components of the plan, including changes in zoning laws and the creation of retention ponds in some locations (Nola 2013).

## PHASE 1:

## VACATING THE LOW(EST) GROUND (2008–15)

34,274 PEOPLE FROM 14.67 SQUARE MILES OF LOW-ELEVATION  
AREA WILL SHIFT TO HIGHER GROUND. THE POPULATION  
DENSITY WILL BE 5,008 PEOPLE / SQUARE MILE.

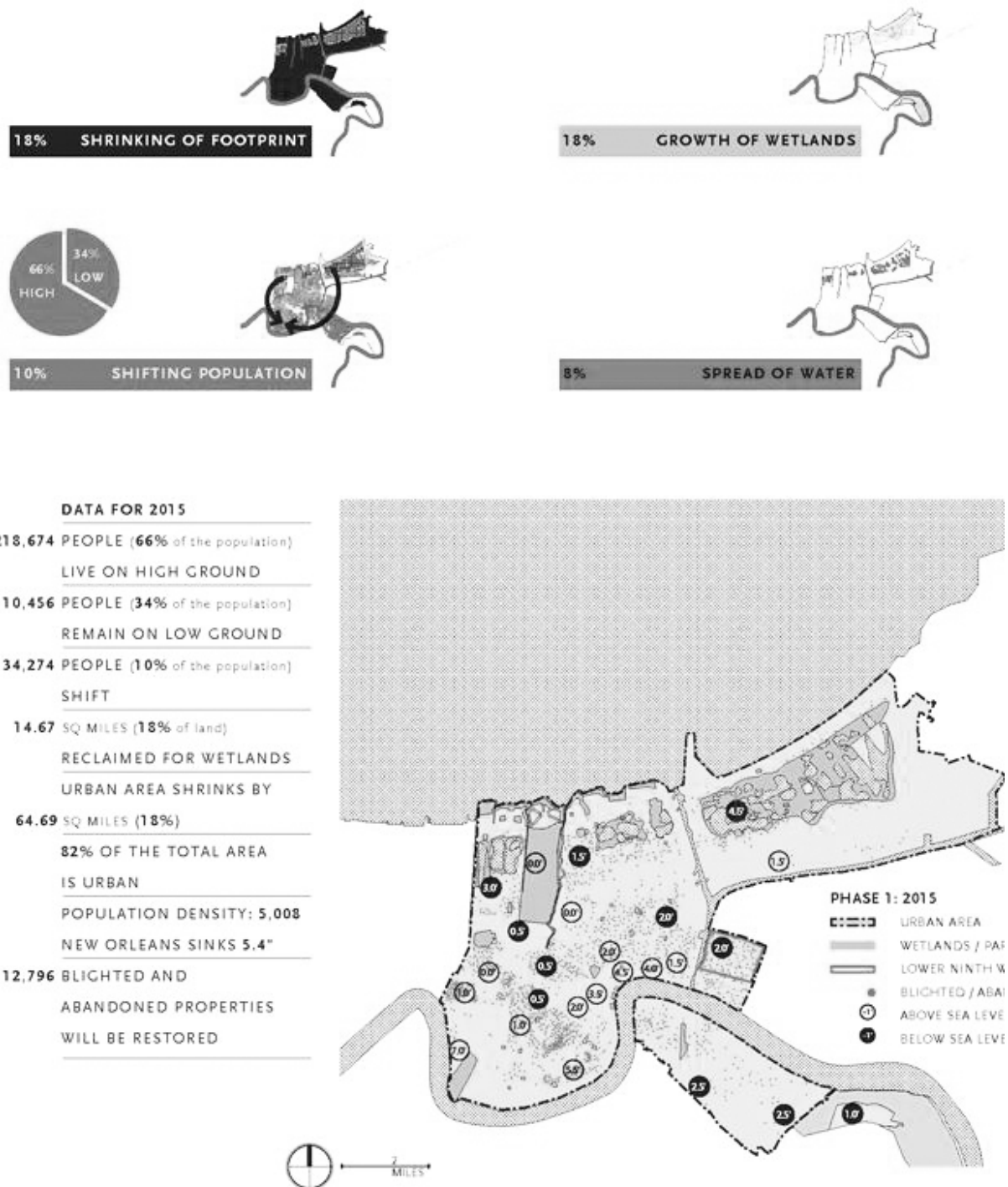


Figure 4-7 Example of reverse engineeringMorphosis, 2012



Figure 4-8 Example of phased master planning of HafenCity, Hamburg, 2013

### 4.3 Case Study 3: Hamburg

The potential for the redevelopment of Hamburg's former port and industrial area in the 1990s initiated the HafenCity project, which is currently Europe's largest inner-city redevelopment project. Hamburg is located on the river Elbe, 120km away from the coast of the North Sea. The funnel shape of the Elbe estuary and prevailing NE wind direction expose the city to the risk of tidal surges. The North Sea flood of 1962 caused the destruction of property of approximately 60,000 people, and a death toll of 315 in the city of Hamburg. In comparison to New Orleans, Hamburg decided against building highly-engineered barriers and developed innovative urban strategies for the creation of a new inner core district that is able to accept flooding (Hill 2011). The early emphasis on a coherent master plan for the HafenCity expansion project allowed for the involvement of multiple stakeholders and design-led, rather than engineering-led, flood adaptation.

The vision for the city of Hamburg was to recreate its identity as an international waterfront city. The investment in the port and waterfront was to enable a 40 per cent expansion of the city centre's inner core, to strengthen the residential role of the city centre and to establish new economic, cultural and recreational opportunities (HafenCity 2009). With the port area situated outside of Hamburg's line of flood protection, the new development required a holistic approach as well as active participation from all sectors and stakeholders to develop long-term and innovative flood adaptation strategies. The model of the architectural master plan competition is seen here as a pivotal tool in the planning and implementation stages of HafenCity.

#### **Planning and Master Plan Competition**

Instrumental in involving different stakeholders was the formulation of a coherent design strategy. This facilitated the negotiations the city of Hamburg needed to conduct with the port authorities, private investors and the general public. In the early stages of the project, an urban feasibility study and visualisations were done by architectural practice von Gerkan, Marg and Partners (GMP), and formed the basis for discussions between the city and the port authority. Studies to regenerate Hamburg's water edge formed the basis of a long-term design-led master plan, which shaped the programming and urban structure for the site. With the acquisition of the necessary port sites the then mayor, Henning Voscherau, was able to develop 'Vision HafenCity', which was presented to the Hamburg Parliament in 1997 and approved in the same year (Hill 2011). The GMP study was further developed to allow the city and port authorities to review objectives, concerns and visions for the project. Hamburg's



future development plans and considerations for flood protection, traffic and social infrastructure were integrated to establish the framework for an international urban master plan competition launched by the City of Hamburg in 1999 (HafenCity competition).

The use of the competition model proved to be effective with regard to long-term urban development and flood adaptation, attracting a large number of entries of high-quality. The competition was also of economic and promotional benefit for the city. The HafenCity competition received 175 entries from multi-disciplinary teams that included urban planners, architects, landscape designers, traffic experts and economists. A holistic evaluation of the eight shortlisted proposals was conducted by a jury panel of urban planners, architects, representatives from the city planning office and the private sector. From an economic point of view these long-term gains far outweighed the costs of running the competition.

The winning entry by Hamburgplan, a Dutch-German collaboration on flood protection and urban development. Moving away from conventional forms of large-scale engineering flood protection, Christiaanse's scheme embraces the Dutch concept of allowing water in, and goes on from the proposals previously developed by von Gerkan, Marg and Partners. It proposed first, floating docks that rise and fall with the 3-meter tidal shifts of the river Elbe. Second, waterfront promenades for walking and cycling and various floodable public spaces at 4 to 5.5 meters above sea level, and, last, streets and buildings raised on 7.5 to 8 meter high flood-protected bases. In terms of a flood adaptation strategy, the HafenCity development works with water rather than against it. While all building functions are protected on raised bases, two thirds of the new public spaces on the waterfront promenade level are designed to anticipate floodwater. The floating pontoon structures to the west of HafenCity are able to rise with changes in the water levels, and the choice of hard surfaces for the terraces immediately next to the waterfront can be easily washed off when waters recede. It is expected that these areas on average could flood twice or three times a year - sacrificial zones that give water space rather than contain it.

### **Planning Strategies**

The ASTOC/Christiaanse concepts also rationalised the financial, programming and long-term planning strategies for the new development. The financing of HafenCity was based on strong public-private investments that pay for the costs for flood protection. Three main investment groups financed the project: The City of Hamburg, HafenCity GmbH - a limited-liability private company owned by the City of Hamburg - and the private sector. The City of



Hamburg contributed 550 million Euros toward the cultural and educational facilities. HafenCity GmbH, a limited-liability private company owned by the City of Hamburg, contributed 750 million Euros to fund the entire public infrastructure that includes streets, parks, promenades and quay walls. The company was set up to administer the former port areas and according to its official brochure, apart from its financing responsibility, it 'also clears and prepares sites, plans and builds infrastructure and public spaces, acquires and contracts real estate developers and larger users, and is responsible for public relations and communication' (HafenCity 2012, p.4). At 5.5 billion Euros, the private sector was the largest contributor to property development. Under the terms of the master plan, developers were required to finance the construction of the raised plinths for their prospective developments. By regulating the flood protection directly with private investment, the City of Hamburg dispensed with any need for additional public flood protection financing in the future.

Christiaan's emphasis on mixed-use and phased planning also contributes to the success of the master plan. Apart from the creation of public space, the development of HafenCity encouraged economic growth of new industry sectors and tourism for the city. There are further projections to create 6,000 new homes and the creation of 45,000 service sector jobs. A mixed-use strategy devoted 56% of land to services and tourism, 33% to habitation and 8% to culture, science and education. While 25% of the land is for street and transportation infrastructure, and 4% is for private spaces not accessible to the public, the remaining 70% of land is divided equally between buildings and spaces that are accessible to the public (Sepe 2013). The new cultural venues, educational facilities, leisure and recreation are as important as creating an urban mix for commercial use and adjacent residential spaces. This mix of programmes along the new waterfront area creates complementary programmes to Hamburg's historic inner city.

To phase the construction of the project, the master plan was divided into thirteen zones, developed in sequence starting from the north to south and from the east to west. Construction of the phases is expected to run to 2025, with portions of HafenCity already completed.

### **Strategic Design Implementation**

HafenCity developed a portfolio of flood adaptation strategies that include 'grey innovations' (e.g. raised mounds, floating platforms, waterproofing flood base) and the implementation of non-structural measures such as flood warning systems, zoning strategies and building

codes. The adaptability to shifting water levels, multiplicity of socio-economic programmes, and sustainability of long-term urban development and flood protection are all applied here.

Adapting and opening the city to water creates new types of topography that generated the district's economic and cultural value. The landscaping designed by EMBT Architects, for instance, connects the three levels of floating pontoon, promenade, and raised building terp through terraced landscaping, creating amphitheatre-like forms of public space. These generously laid out terraces connect the public squares on the waterfront to the semi-public spaces on street level, creating dynamic spaces of transition and areas of occupation for the city. Two of these terraces, the Magellan Terraces and Marco Polo Terraces, are treated with different materials to give them distinct character - the first is urban in nature through its use of hard surfacing, while the latter is given softer curves and is interspersed with grass islands and wooden decking. The architects have also landscaped smaller more private squares along the promenade, creating a diversity of public and semi-public experiences between water and urban fabric. What connects the spaces is the material reference to Hamburg, using clinker brick on external quay walls and patches of ground surface, trees such as oak and willows and other local vegetation 'that will change the look of the port according to the season of the year' (EMBT n.d.).

The focus on the activity at ground level is highlighted in the master plan. Functions that are classed as secondary to urban life, such as underground parking for stationary vehicles, are placed within the raised building plinths. As a result, the new roads require only a minimum of parking facilities within the public spaces, and roads are primarily designed for movement not as car storage areas. This activates the urban ground. According to Christiaanse, programmes range from 'large-scale social amenities, such as a new concert hall, a cruise terminal and a science museum; to mid-scale activities such as shopping, offices and hotels; to small-scale residential programs by private builders, schools and crèches. The communities in these neighbourhoods will have to evolve on their own — we cannot design them. But a diverse and flexible urban design can stimulate encounter and thus interaction' (Christiaanse 2009).

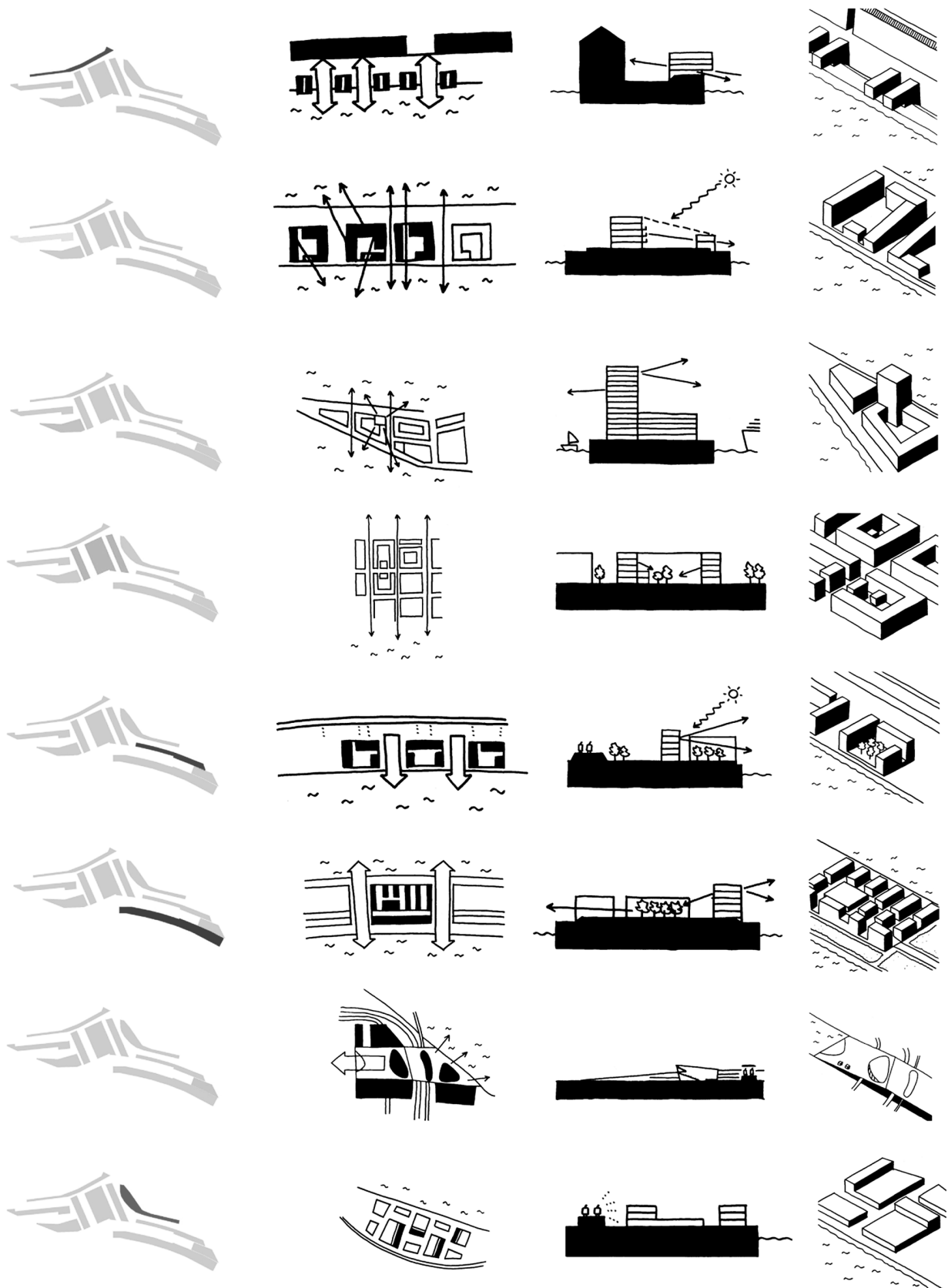


Figure 4-9 Diagrams of urban design principles for master plan development of HafenCity, KCAP

#### 4.4 Developing Transferable Design Strategies for Manila

	Design Examples	Design Outcomes	Transferable Design
<b>Case Study 1 Dhaka</b> <b>‘Tactical Interventions’</b>	Informal Settlements Waterstudio NL Ashraf	Coping Strategies Floating Urban Structures Liquid Landscape Proposals	Typology Building - Grey Typology Building - Grey Typology Ground - Grey
<b>Case Study 2 New Orleans</b> <b>‘Making Space for Water’</b>	Morphosis Gans Studio Waggonner & Ball	Making Space for Water Neighbourhood Planning International Exchange	Reverse Engineering - Green Participatory Model - Soft Knowledge Exchange - Soft
<b>Case Study 3 Hamburg</b> <b>‘Flexible Development’</b>	KCAP  EMBT	Urban Strategy Phasing Strategy Ground Strategy	Urban Mix - Soft Phased Development - Soft Typology Ground - Grey

With Manila having low environmental awareness, a low capacity to invest into flood adaptation and poor environmental governance, the challenge for the designer is to develop ways to demonstrate the benefits for environmentally-led flood adaptation plans that can be resourced and maintained at a local neighbourhood scale.

While the climatic, political socio-economic and cultural contexts of New Orleans, Dhaka and Hamburg are not directly relatable to Manila’s, their efforts towards flood-preparedness provide important clues for the city: Dhaka has been able to adapt with scarce resources and ‘tactical interventions’, New Orleans has experienced a drive to increase local environmental awareness to ‘make space for water’, and Hamburg has been able to develop a ‘flexible master plan’. They therefore represent a range of approaches to flooding from a range of starting points that can form the basis for an alternative conceptual design framework for Manila – one that pays attention to both the environmental and urban challenges that the city faces. The case study matrix is instrumental in informing design tactics and strategies for Manila.

In the design matrix (see figs. 4-10 and 4.11) design interventions are ordered by type (‘grey’ – engineering-led, ‘green’ – environmentally-led, ‘soft’ – policy-led) and scale, and considered in relation to the particular governance and resource challenges of Manila. Appropriate design interventions are then chosen for their ecological merits. This transfer, it must be stressed, is not an attempt to establish a direct translation from one city to another. Instead it acknowledges that each context is different. One can, however, identify ideas and principles that meet local contextual challenges. This approach puts equal emphasis on what the case studies cities did, and how they got there, from which transferable design strategies for Manila can be developed.

					A1	A2	A3	A4
GREY	Flood Protection	■ Flood Barriers	●○○	○				
		■ Underground Cistern	●○○	○				●
		■ Hard Surface	●○○	○				●
		■ Flood Shelter	●○○				●	
		■ Flood Wall	●●○	○				
		■ Sloped Ground	●●○					●
		■ Elevated Ground	●●○					●
		■ Dike Flood Defences	●●●					
	Flood Adaptation	■ Sacrificial Basement	●○○	○				
		■ Flood Resilient Materials	●○○	○				
		■ Floating Buildings	●○○					
		■ Amphibious Buildings	●○○			●		
		■ Pile Buildings	●○○					
		■ Hard Surface Channels	●●○	●				
		■ Hard Surface Collectors	●●○	●				
		■ Flood-Resilient Streets	●●○	●				●
		■ Elevated Escape Route	●●○	●				
GREEN	Blue Systems	■ Rain Water Gutters	●○○				●	
		■ Water Basins	●○○			●		●
		■ Water Tank Storage	●○○				●	
		■ Water Corridor	●●○					
		■ Water Courtyard	●●○	●				
		■ Water Pond/Well	●●○			●		
		■ Water Recycling	●●○					●
	Green Systems	■ Soft Surface	●○○					
		■ Green/Blue Roofs	●○○					
		■ Berm	●●○			●		
		■ Planted Routes	●●○			●		
		■ SuDS Swales	●●○			●		
		■ Green River Edge	●●○					
		■ Green Roofscapes	●●○					
		■ Parks/Wetlands	●●○			●		
SOFT	Political Actions	■ Competition Models	●○○					
		■ Participatory Practices	●○○				●	
		■ Zoning	●●○				●	
		■ Warning Systems	●●○				●	
		■ Reverse Engineering	●●●				●	
	Economic Actions	■ River Transportation	●○○	●				
		■ Floating Livelihood	●○○				●	
		■ River Promenades	●●○	●				
		■ River Activities	●●○			●		
		■ Flexible Public Space	●●○	●				
				●	●			

Figure 4-10 Categorisation of flood adaptation typologies into 'grey', 'green' and 'soft' design measures



UNIVERSAL FLOOD MANAGEMENT CATALOGUE




















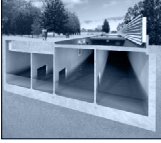




GREY ADAPTATION ACTIONS				GREEN ADAPTATION ACTIONS	
FLOOD PROTECTION		FLOOD ADAPTATION		BLUE SYSTEMS	
	FLOOD BARRIERS		SACRIFICIAL BASEMENT		WATER BASINS
	UNDERGROUND CISTERN		FLOOD-RESILIENT MATERIALS COPING		RAIN WATER GUTTERS
	HARD SURFACE		FLOATING BUILDINGS		WATER TANK STORAGE
	FLOOD SHELTER		AMPHIBIOUS BUILDINGS		
			PILE BUILDINGS		
	FLOOD WALL		HARD SURFACE CHANNELS		WATER CORRIDOR
	SLOPED/TERRACES GROUND		HARD SURFACE COLLECTORS		WATER COURTYARD
	ELEVATED GROUND		FLOOD-RESILIENT STREETS		WATER POND/WELL
	ELEVATED ESCAPE ROUTES		DIKE / FLOOD DEFENSES		WATER RECYCLING

Figure 4-11 Universal flood management catalogue ordered by grey, green, soft designs and scale

GREEN SYSTEMS		SOFT ADAPTATION ACTIONS		POLITICAL ACTIONS		ECONOMIC ACTIONS	
	SOFT SURFACE				NEW ORLEANS LUIS BASABE TACTICAL URBANISM FLOOD TAX		RIVER TRANSPORTATION WATER TAXI/BUS
	GREEN/BLUE ROOFS						FLOATING LIVELIHOOD
	PLANTED ROUTES		ZONING				RIVER PROMENADES
	SUDS SWALES		WARNING SYSTEMS				RIVER ACTIVITIES
	GREEN RIVER EDGE						FLEXIBLE PUBLIC SPACE
	GREEN ROOFSCAPES						
	PARKS /WETLANDS		REVERSE -ENGINEERING				



Figure 5-1 Satellite view of Manila and mouth of Pasig River







*Figure 5-2 Aerial view of Manila and Pasig River*







Figure 5-3 Image of research of cities and flooding, 2014

## Chapter 5: Strategies and Tactics for Design

This chapter examines Manila's urban ground and the practical application of ecological urbanism strategies and tactics along the city's flood-prone riverbanks. It describes how ecological urbanism provides a methodological framework for design with the aim to establish an environmental and cultural balance for flood-affected sites in Manila. Embedded with environmental, socio-economic, political and cultural complexity these require an equally complex range of insights and approaches to respond to current and future flood challenges (Mostafavi 2010).

The question of connectivity between the 'natural' and 'constructed' ground was the key driver for the practical design study of this thesis. This, on the one hand, referred to physical connectivity and the unhindered flow of urban movement in dry and wet seasons. On the other, it referred to the metaphoric bridges between the diverse urban functions, social classes and cultural memories associated with Manila's river. From a practical point of view, the design study asked how the city could 'make space for water' and human habitation. What types of design could help Manila's flood banks to remain physically connected during flooding? At the same time, could the same forms of design intervention also enhance existing cultural and socio-economic networks? The questions of physical and metaphorical connectivity were explored through a series of the tactical interventions with the aim to develop an ecological infrastructure along the flood areas of the Pasig River – an infrastructure that could balance Manila's natural water and flood cycles with human habitation.

This chapter is structured in three parts: 'Insights', 'Strategies' and 'Tactics' for design. This structure is used to describe and reflect on current conceptual challenges, practical approaches, and potential design methods that could be applied in Manila. The practice-based design study of this research was developed in dialogue with this structure. In Part One of the chapter, the interface between regional and local flood challenges are described through three test study sites. Design methods from ecological urbanism are then used to analyse and unravel the complexities of these three ground typologies. Part Two constructs a strategic framework for design that considers flood management in conjunction with flexible urban planning over time. This three-tiered strategy forms a holistic approach to flood management paying equal attention to environmental and urban design performance. Part Three focuses

tactics and the systematic application of possible design interventions. The design research therefore becomes the platform to test the ability of the interventions to respond to flooding on different sites and to assess the additional urban value that could be generated for the Pasig's riverside communities.

In the process of 'research by design', drawings were key in translating concepts of adaptation to spatial interventions. As an analytical tool, drawings enabled the first critical reading of the conditions and processes that defined each case study site. Second, they were also used as tools to test and inform the range of possible interventions. Third, drawings were a means to speculate on the impact of design from a local to a river-wide scale.

Strategies and tactical tools were used to develop site-specific responses to flood and urban challenges, and the performance of design was measured in three ways. From an environmental perspective, the study questioned how well the interventions could respond to speed, elevation and duration of flooding. Under such conditions how much urban connectivity would be retained? From an urban perspective, the study questioned design could also foster accessibility and flexibility in a multiplicity of urban programmes. Finally, the strategies and tactics were tested in specific test locations to examine them in terms of contextual relevance and likely implementation: how well could the proposals respond to Manila's particular economic, political and cultural capacity to engage with design-led change? The study evaluated how well a system of interventions could consider these environmental, urban and contextual factors simultaneously.

## 5.1 Insights into Manila's Ground

In their cartographic representation, the edges of the Pasig River are drawn as well-defined lines that meander through Manila's irregular urban fabric. Only more recently developed flood maps of the city provide a more accurate representation of these water edges as gradients that shift between wet and dry. The urban ground along the banks of the Pasig is defined by this dynamic field, which requires alternative ways for design to conceptualise, represent and act on the river's natural flows and overflows.

From an ecological point of view, the strict dichotomy between wet-dry in Manila's areas of flood risk needs to be challenged. The prejudice of planning toward dry 'land use', insufficiently

describes the dynamics of water and flooding that occurs on this type of urban ground. This, for example, is reflected in the terminology of Manila's 'Comprehensive Land Use Plan and Zoning Ordinance' from 2006, which sets out the codes and guidelines for the city's future urban development. The plan's rigid division into distinct commercial, institutional, educational and residential districts also indicates how potential development of flood-risk areas remains locked in planning concepts of land-use and controlled zoning. These strategies still favour a fixed notion of development over adaptable living. As local architect Arlene Lusterio observes: 'still no planning or design guidelines exist for land under water or development in or on water. Current laws and standards do not include water as buildable space.' (Lusterio 2011, p. 151).

An alternative way of framing the flood zone that was used for the design research project is the concept of a continuous field condition. The notion of the field, as presented by architectural theorist Stan Allen, allowed for the city to be read not through the traditional distinction between figure versus ground, but instead be understood through the interrelated dynamic forces that shape a place (Allen 1997). In this sense, one was able to interpret Manila's diverse urban conditions along the Pasig as different gradients of intensity: from built to unbuilt form, and visible to invisible processes. The natural flows and overflows of the Pasig were simply considered as part of this field. This suggested a new perspective of 'water as ground' that led to alternative adaptive urban strategies found in ecological urbanism. It called for a conceptual shift from *Terra Firma* to *Terra Fluxus* (Corner 2006) – design approaches that were spatially flexible, and dynamic over time.

Moving from conceptual framing to practical application, the design study shifted its attention from the river as a whole to a neighbourhood scale. Seeing Manila's river edge as a dynamic field condition presented an opportunity to rethink how different districts and neighbourhoods could adapt to flood conditions and connect to the river. In terms of design interventions, how could these respond to the particular urban conditions, forces and processes of a site over time? Could design also help neighbourhoods connect better to one another during flooding? The river edge was explored through the different urban morphologies that have developed along the Pasig River. Starting with the historic colonial neighbourhoods at its mouth, the study continued with the industrial zones that have established themselves, and the ubiquitous informal settlements along the river edges (Alejandro 2000, Alcazaren 2011).



### **Testing and mapping Manila's historic, post-industrial and informal ground**

Three test study sites typifying these settlement conditions along the Pasig were therefore selected for the design research. The first site, Binondo, located in the lower catchment of the river, is representative of the historic part of Manila. The second, Santa Ana, is a post-industrial site, and the third, Punta, an informal settlement, both within the middle catchment area of the river (Robas2014). The choice of sites was determined by the ways they displayed different flood conditions on the one hand, and varying types of urban fabric, urban communities and development patterns on the other. With a range of challenges set out by the particularity of three case studies, the design study considered the strategic aims for flood adaptation and the tactical means to achieve these. Each of the sites thus became test beds for ecological urbanism.

Two mapping techniques were used to analyse the three case studies. Cartographic mapping and personal photographic surveys were conducted to describe the ecology of the different types of urban ground the case studies typify. As an analytical tool, this mapping provided the necessary insights to plan and eventually propose architectural design interventions for the neighbourhoods. This provided a critical overview of the flood patterns in relation to the local social, cultural, economic and political environments that defined each place. All of these factors needed to be considered in order to address the interdependent issues from the perspective of ecological urbanism. The mapping and surveying methods also provided two complementary vantage points to fully describe Manila's urban ground. Where mapping described a measured and quantifiable means of representing data, the photographic survey provided for more a personal and qualitative understanding of the sites.

The mapping techniques for this design study were based on analytical design methods established by landscape architect Ian McHarg. An ecological inventory (Mc Harg 1995) was undertaken of all three case studies, which began with the hydrology, topography and soil typology of the sites and mapped these against their particular social and cultural values. The careful cataloguing of these urban layers formed a checklist of interrelated systems, which not only provided an understanding of Manila's diverse urban ground, but also formed a method of analysis that exposed each site's particular challenges and opportunities for design (Spirn 2014). For each case study site, aerial satellite views were prepared and overlaid with soil, topographic, storm drain-, and flood risk maps (taken from a 2010 flood risk study conducted by the Japan International Cooperation Agency). This form of layered cartographic representation allowed for city- to local-scale concerns to be represented, which in turn informed the strategies for the different ground conditions. The resulting maps and illustrations thus formed an intersection between documentation and design intervention (Corner 2006).

While the mapping exercises provided a quantitative reading of three case study sites, a series of photographic surveys offered a qualitative one (Hawley 2012). The surveys were conducted during field studies in 2014 and 2015 in order to construct specific readings of the neighbourhoods. The sites' ferryboat stations formed the starting points for the surveys from which a 400m-walkability radius was drawn. Walks along the river and the urban ground conditions within this catchment area structured the observations. In the first instance, photographic subjects were chosen intuitively, which in the later design process established relevant themes and objectives for the design project. For each case study, photographs were ordered into a catalogue to document the range of spatial conditions and types of occupation related to each site. Consequently, the surveys created a textural understanding of the urban ground, which captured the separate layers of environmental, architectural and social conditions of Manila at eye-level.

Compared to the abstract nature of the cartographic mapping study, the photographic survey introduced a concrete dimension. For example, drawing anticipated flood levels into key site photographs provided a visual understanding of the particular challenges and opportunities for design in particular places. This suggested that interventions below the horizontal flood line would require a high degree of resistance to flood speed and duration, while interventions above the maximum flood height could contribute to the capturing and storing of rainwater to reduce flood impact at ground level. Furthermore, the physical frameworks that would connect potential interventions above and below this flood line would require equal consideration in relation to resourcing, procurement and relation to local character. The understanding of topography, spatial conditions, inhabitation and anticipated water levels in the historic, post-industrial and informal neighbourhoods drove the subsequent design interventions.

Apart from capturing qualitative characteristics, the photographic survey also captured some of the flood management processes that are currently being implemented in Manila. From this a separate photographic evidence catalogue was established, which documented current flood management policy, and its spatial implications on site. The identification of specific 'processes over time' became a key element of the design study. As landscape architect James Corner remarks, the understanding of urban processes is 'much more significant for the shaping of the urban relationships than are the spatial forms of urbanism in and of themselves' (Corner 2006, p.28). The photographic survey captured what effect current engineering responses and planning devices have on the river edge.

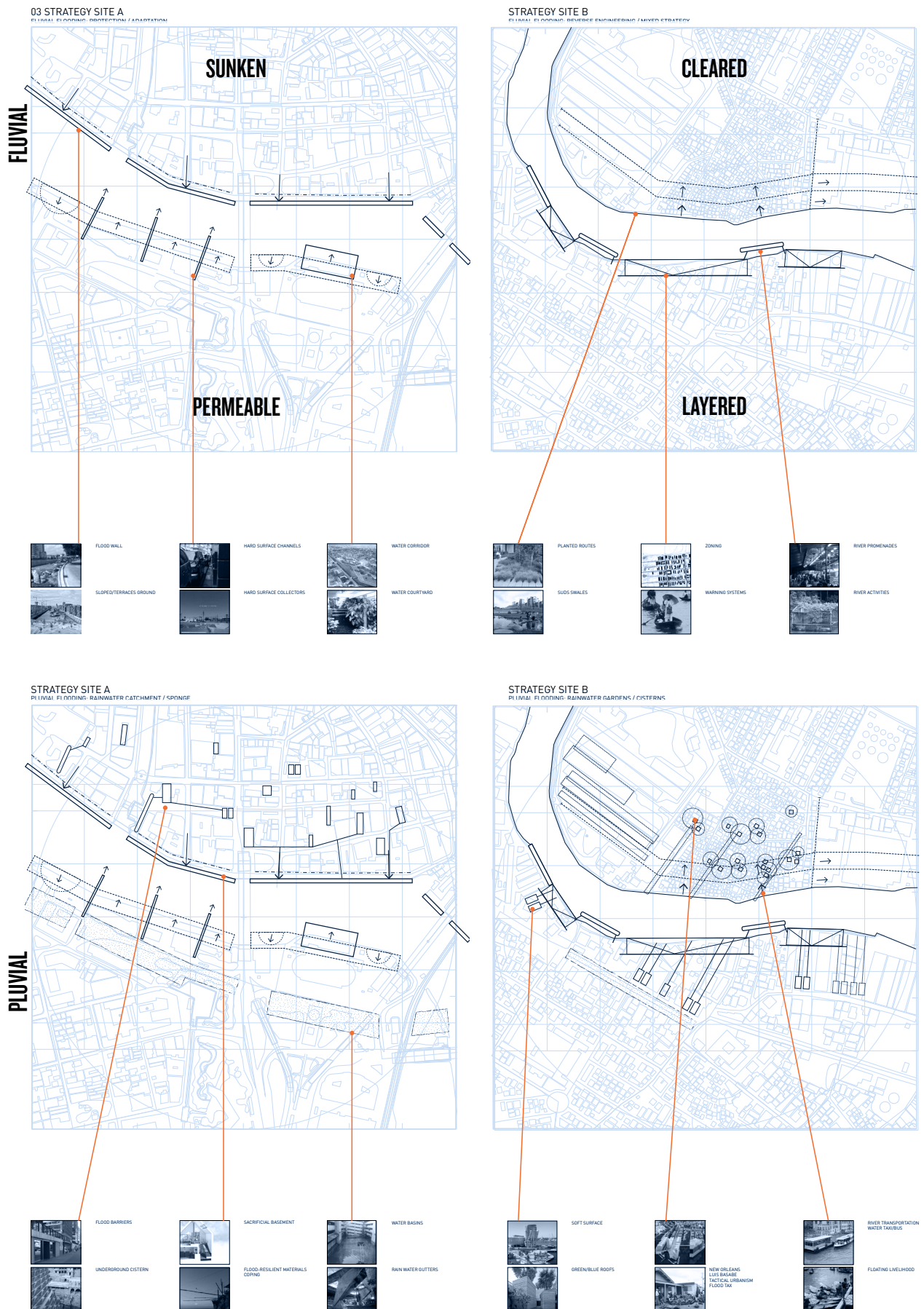


Figure 5-4 Diagrams of fluvial and pluvial flood management for historic neighbourhood (left) and post-industrial and informal neighbourhoods (right)

## 5.2 Design Strategies

### **A three-tiered ecological strategy**

A design-oriented strategic framework was proposed for Manila that could address future flood challenges through the elaboration of ecological urbanism strategies. Modes of operation, particularly from landscape urbanism (Corner 2014) and urban design (Gehl 2011) informed this framework. The physical, environmental and social relationships between areas at flood-risk and the rest of the city were addressed through the overarching concept of connectivity. The insertion of new designed environmental and urban components were used to grow a network of interconnected systems to complement Manila's existing urban grain. From an environmental perspective, the interplay between these was intended to repair, secure and develop the river ecosystem over time. Connecting the design research to the earlier case study cities, the principles of 'making space for water' (New Orleans), 'tactical interventions' (Dhaka) and 'flexible planning' (Hamburg) were also translated to formulate a three-tiered strategy.

#### **5.2.1 Strategy 1: Environmental Framework – and 'Making Space for Water'**

Ecological urbanism served as an overarching model to reconceptualise the river banks as dynamic ground that could accept the uncertainties of recurring floods and at the same time reorganise and manage the complexities of potential human activity (Corner 2014). The objective was to enhance existing ecosystems along the river edges and to introduce new ones where possible.

The environmental framework started by identifying natural assets in order to develop an ecological infrastructure that could enhance the notion of 'making space for water'. The reintroduction of a green river front made direct reference back to the Burnham Plan's description of the banks of the Pasig as 'shaded drives [...] continuing up the river' with promenades 'made available for the use of the public' (Burnham in Moore 1968, p.181). In addition, the design strategies referred to the recently enforced easement laws that require 10 metre minimum clearances along public waterways (MMDA directive 1996), and redefined Manila's river and canal edges as a zone in which urban and natural ecosystems could be designed to interconnect. The proposed widening of the urban canals would provide functional and aesthetic lines of connection through the city, but equally could serve to reduce the danger of overflow from the river (Balgos et al. 2015). Historical references and current legislation provided a crucial starting point for the proposed environmental framework.





Figure 5-5 Design strategies divided into environmental, urban and temporal frameworks. Left: Historic neighbourhood. Right: Post-industrial and informal neighbourhoods



The environmental strategy differentiated between two flood types that affect Manila: fluvial flash flooding, as a result of sharp heavy rainfall, and widespread pluvial flooding related to long persistent rainfall (Bankoff 2003). Both types of flooding represented different types of risk that require the city to protect itself - from high velocity river currents during fluvial flooding, and from flood depth and duration caused by pluvial floods. The proposed environmental strategy therefore looked at two strategies: first, 'making space for water' and second, the introduction of environmentally-led infrastructures that could 'delay', 'channel' and 'store' water (OMA 2013).

The concept of 'making space for water' was applied to the edge of the Pasig River. On a strategic scale, zones were identified where it would be safe or unsafe to build. This informed where to retreat from or protect against oncoming floodwater, where to dredge the river bottom to enable more predictable flows, and finally, where depressions needed to be created to contain and control overflows.

Making space for water also required the consideration of the ratio of permeable to impermeable ground, and whether a change of functions within the city would be able to reintroduce more permeable surfaces within the city. An increase in linear parks along the river edge over time, for example, could both act as designated flood spill areas, and increase the city's recreational areas. The consideration of topography and permeability could be applied to the retrofitting of existing urban condition, as well as to areas being prepared for new development. By placing emphasis on the interplay between the environment and the urban, the notion of permeability – and making space available – was key to 'allow for future permutation, affiliation and adaptation' (Corner, 2003, p. 60).

The management of pluvial rainfall required equal design attention. With current drainage systems out-dated or unable to cope with extreme levels of rainfall, alternatives for water collection, storage and channelling would be required for extreme downpours, as well as options to control the discharge of superfluous rainwater. New blue/green infrastructures were proposed to be woven in perpendicular to the Pasig River, to connect the river edge to other pockets of open spaces in the city. Applied systematically, this secondary 'green' strategy systematically could complement the existing grey infrastructure, and through delaying/storing/releasing rainwater introduce principles of sustainable water harvesting and recycling into the city (OMA 2013). Rather than rely solely on engineering solutions to flush away rainwater, the introduction of green roofs, SUDS and water catchment basins would allow the

city to reduce, reuse and recycle rainwater. Applied at a neighbourhood scale, the strategy was to grow this system incrementally, and increase flood resilience through water channelling and harvesting.

### **5.2.2 Strategy 2: Urban Framework – and ‘Tactical Interventions’**

In parallel to the environmental strategy, a new urban framework was introduced to direct urban renewal patterns toward the river. These lines of redevelopment were tied to the nodal points of the river ferry terminals and to the environmental network set up across the city. The urban framework should not be understood in the traditional sense of land-use and zoning, but much more in the ecological urbanism sense of a layering of programmes. Landscape urbanist Alex Wall defines this as the ‘programming of the contemporary urban surface to create specific relations’ (Wall 1999, p.234) (rather than sculpting and shaping the environment in a formal way). For Wall, the urban surface is the supporting field from which programmes and buildings emerge. The programmes and buildings it produces are less important for the designer to consider than the ‘extensive and intensive ground-plane of the city... the ground structure that organises and supports a broad range of fixed and changing activities’ (Wall 1999, p.238).

Through tactical interventions in neighbourhoods along the river, existing socio-economic activities would potentially be changed or augmented. The activation of the riverfront could lead to the re-introduction of commercial and tourist activities, and at other points, can strengthen the river’s ecosystemic and recreational potential. The strategic improvements would not be limited to just individual sites. The plans for improvement could start on one side of the river but could also be mirrored on the opposite side in order to create new links between two different neighbourhoods. The urban framework would introduce new programmes to the neighbourhood and support the local activities already in place.

To understand the constructive interplay between the environmental and urban strategies, the first could be regarded as the preparation of the ground, and the second as the creation of a new layer that would begin to physically and culturally connect with the existing natural and urban fabric. The continuation of movement and everyday life during flooding events was the key concern of the urban strategy, so that interventions would need to work in wet and dry states.

The example of Manila’s local canal restoration project demonstrated (see Chapter 2 – opportunities for design) that environmental improvements of local waterways could be implemented in tandem with urban design intervention. Different stakeholders and the city

government worked together for the effective monitoring, servicing and maintenance of the flood infrastructures. This in turn, has enabled the neighbourhood to invest into local amenities (market renovation) and housing. The creation of such local improvements and the tactics around these would allow us to rethink traditional and out-dated patterns of land-use and zoning.

### **5.2.3 Strategy 3: Temporal Framework – and ‘Flexible Master Plans’**

The third strategy considered flexible development over time. While it was important to develop an overall ecological and urban vision for the city, the project acknowledged the decentralised governance of Manila. Urban change therefore needed to be considered through smaller-scaled projects. This would allow design interventions to be implemented appropriately over time, as funds permit. James Corner’s term ‘staging ground’ provided a useful concept to work from. He describes this as preparation of the urban ground that through phased interventions can grow into a diverse network of activities. The notion of ‘staging’ sites would allow the community to use and programme the urban ground in different ways creating an urban environment that is responsive to change (Corner 2006).

For the research project the concept of working within a temporal framework implied finding opportunities for design intervention not only in physical sites but also in urban processes. Design thinking could equally be applied to long-term infrastructural developments, such as the city’s transportation network (ferry boats) and flood management infrastructure, as to ‘staging’ local neighbourhood improvements. In time, and through incremental improvements, design-led interventions could create destinations along the river, introduce new programmes, encourage investment in local neighbourhoods, and could reconnect people to the river.

## **5.3 Tactical Designs**

### **5.3.1 Tactical Approaches**

With Manila historically having failed to implement its own large-scale flood master plan projects, the design research explored alternative modes of design intervention, which are able to respond to the dynamics of the city’s flood management more effectively. Given Manila’s decentralised governance structure, local tactical design interventions were developed that would tackle flood challenges at a neighbourhood level that could proliferate as a network. These consisted of pieces of urban acupuncture, which could be inserted into the existing urban metabolism. Similar to the effect of acupuncture is supposed to have on the human body, the

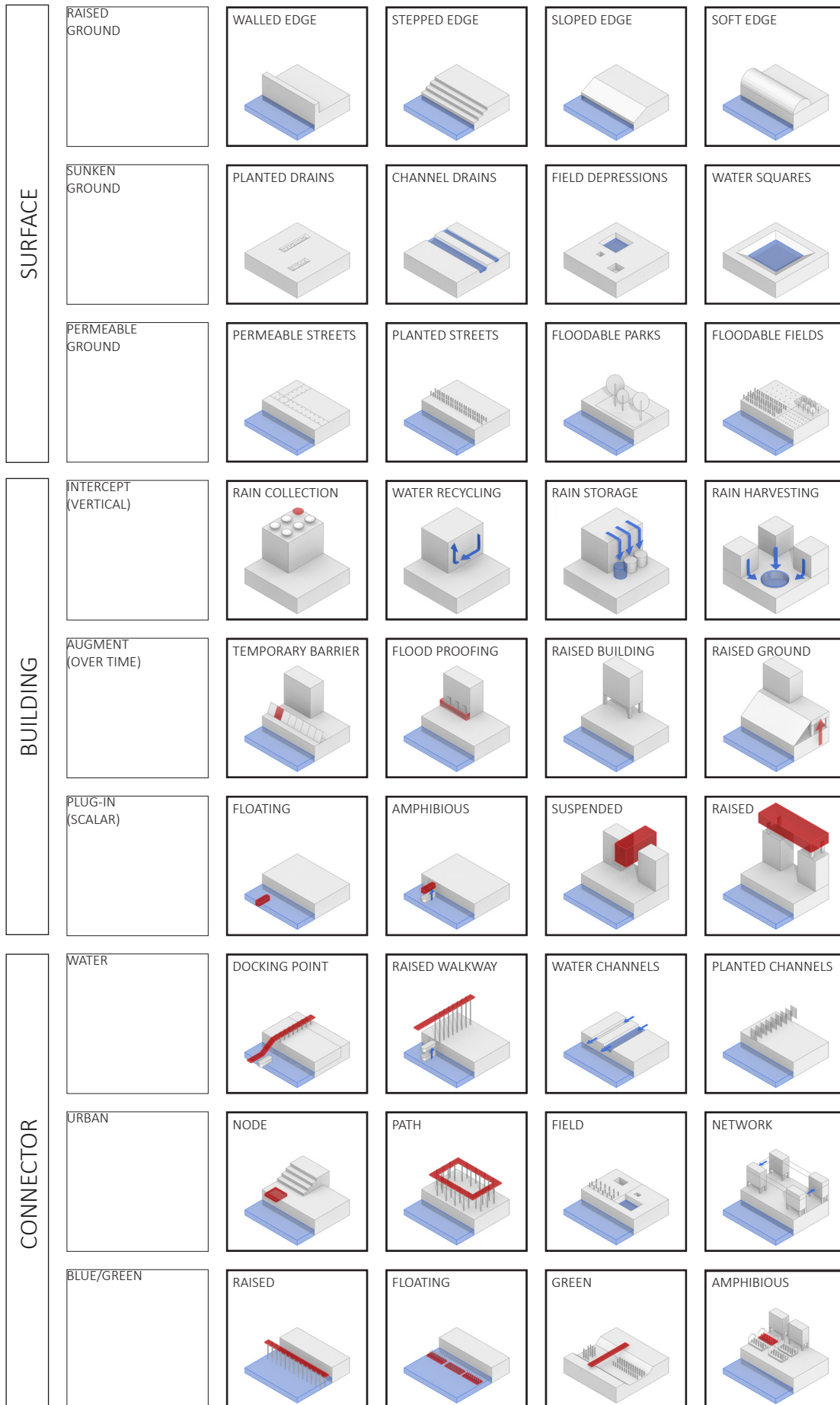


Figure 5-6 Tactical design components. Spatial components categorised into surface, building and connector typologies

proposed series of smaller-scale interventions were introduced with the intention to improve the urban flows and functions within these flood zones. This approach draws on the distinction between the concepts of strategies and tactics presented by French anthropologist Michel de Certeau. Linking strategies to institutions and structures of power, de Certeau suggests how those who are not in power need to employ smaller-scale 'tactics' to achieve particular goals. Applied to this urban study, the design solutions that were explored could be initiated by a neighbourhood, and could work in conjunction or even independently from Manila's large-scale flood management plans. Such tactics offering a fresh look at the means and methods by which Manila's urban ground could be reconstructed in order to prepare for future flood challenges.

Tactical design presented a justified mode of operation to address the complexity in Manila's flood zones. This form of design intervention is typically characterised by low cost, quick implementation and perhaps most importantly by the opportunity it presents to bring a community together (Lyndon and Garcia 2015). Over time, tactical interventions could bridge top-down planning with bottom-up initiatives and to work toward longer-term adaptation through successive smaller-scale improvements (Gadanhó 2014).

These urban transformations were tested through a range of design drawings. Proposals for the flood areas were tested within a graphic field consisting of architectural plans, sections, axonometric and perspectival representations that formed a three-dimensional depiction of the urban ground. This enabled the three-dimensional mapping of the environmental and urban forces and the necessary restructuring of the horizontal and vertical surfaces. From an ecological urbanism perspective, the aim was to recognise the relational and systemic nature of these fields. Design interventions were a means to reorganise these fields, and shifts the attention from designing singularities to thinking how these interventions could form open-ended networks within and beyond the three case study sites. Their placement in the public realm further charged the interventions with potential civic value (MMBB 2008).

### **5.3.2 Spatial Components**

The design study constructed an anticipatory framework toward flood adaptation. Three distinct spatial components defined this framework: 'surfaces', 'buildings' and 'connectors' (Lateral Office 2011). As part of the urban ground, each of these components would be able to bridge between architecture and the environment. As small-scale interventions, they were intended to create an ecological infrastructure. 'Surfaces' referred to different horizontal as well as vertical planes – from sidewalks and roofs to more complex water harvesting networks – that are able to



mediate between environmental and urban functions. 'Buildings' were defined as different forms of enclosure that perform as nodes within the urban network, for example floating, amphibious or raised building typologies that could plug into the existing urban grain. 'Connectors' referred to material connections that would bridge immediate to long-term transformations in the city, and in this study, were explored as temporary docking points to raised walkways that could be used during flood season. While these components were at first explored separately, they were tested and developed in various hybrid combinations in order to respond to each specific site condition.

A catalogue of components was developed to provide a portfolio of potential design interventions. To create this catalogue, sample 'surface', 'building' and 'connection' typologies were taken from earlier mappings and surveys of the ground. These were detached from their original context, analysed and abstracted. The resulting catalogue established a range of design elements that in a later step could be systematically transformed, combined and reconnected with other components in the existing field. In a following step, the components were inserted into strategic locations in the case study sites tested and developed. Depending on the particular conditions of a neighbourhood, the components changed in their scalar, formal and material translation. Each of the components would have the potential to be exchanged or upgraded to form new sites for production and recreation. This process produced a multitude of design possibilities: Small to large permeable surfaces, temporal to permanent buildings, hard to green connections began to articulate a rich system of interventions toward local flood adaptation.

The particular flood and urban challenges of each site ultimately defined the choice of components applied to each neighbourhood. The amount of available space, for instance, would determine the type and amount of 'surface' and 'building' interventions one could consider. In the post-industrial neighbourhood larger fields were available to be considered for redevelopment, whereas in the informal settlement space was limited. The urban grain, on the other hand, would define the nature of building interventions that could be considered – whether elements would be inserted into existing gaps or docked on the river edge. Key to the design study was to develop a set of interventions that would derive from the existing conditions. Rather than proposing new typologies, the interventions are to be read as an evolution of solutions that describe potential new ecologies.

### 5.3.3 Plotting Interventions

The design study used two design-specific techniques to explore the spatial and temporal reconstruction of the sites, 'layering' and 'scenario setting'. Layering (Tschumi 1987 Koolhaas 1995) referred to the superimposition of different functional and programmatic layers on top of each other. Through the overlaying of existing and intended programmes on site, a new complex fabric was established which provided an alternative to traditional zoning and master plans. The insertions of new surfaces, buildings and connections into the urban sites created a new field that allowed to reimagine the different sites' current environmental and urban organisation. The study explored how surfaces could become more permeable, existing buildings and spaces could be charged with alternative programmes, and how new networks could allow the neighbourhoods to function both in wet and dry conditions.

The design study also referred to a scenario-planning workshop on 'The Future of Urban Water' in Metro Manila conducted by engineering and design consultants Arup in 2015. The workshop engaged with key participants from a range of public sector and industry representatives to explore the city's urban water challenges and potential solutions. In order to visualise different scenarios, Arup worked with a set of information cards (Arups Drivers for Change: Water 2.0) that highlight trends and issues (e.g. demographics, water, poverty, urbanisation), which may have a significant impact on the built environment. Key recommendations that emerged from the workshop pointed toward local and time-oriented change. The report, for example, underlined the importance of empowered local community planning in order to decrease the reliance on centralised flood protection measures. It also recommended exploring sustainable practices, emphasising, the need to reduce storm water runoff and to explore alternative 'green/blue' adaptation measures to flooding. Taking a long-term view, the workshop highlighted the importance of exploring 'options for more efficient and sustainable local water resourcing with a focus on water reuse and recycling' (Arup 2015, p.57) in order to address Manila's growing urban population.

The mapping techniques, strategies and tactics described in this chapter established the working method for the design study. Mapping provided the necessary insights to operate within the local context, and the strategies and tactics provided tools to conceptually frame and act on Manila's flood affected river sites. With the historic, post-industrial and informal sites forming the testing ground for eco-systemic interventions, alternative urban configurations could be explored to draw up new spatial relationships toward flood-sensitive urbanism.

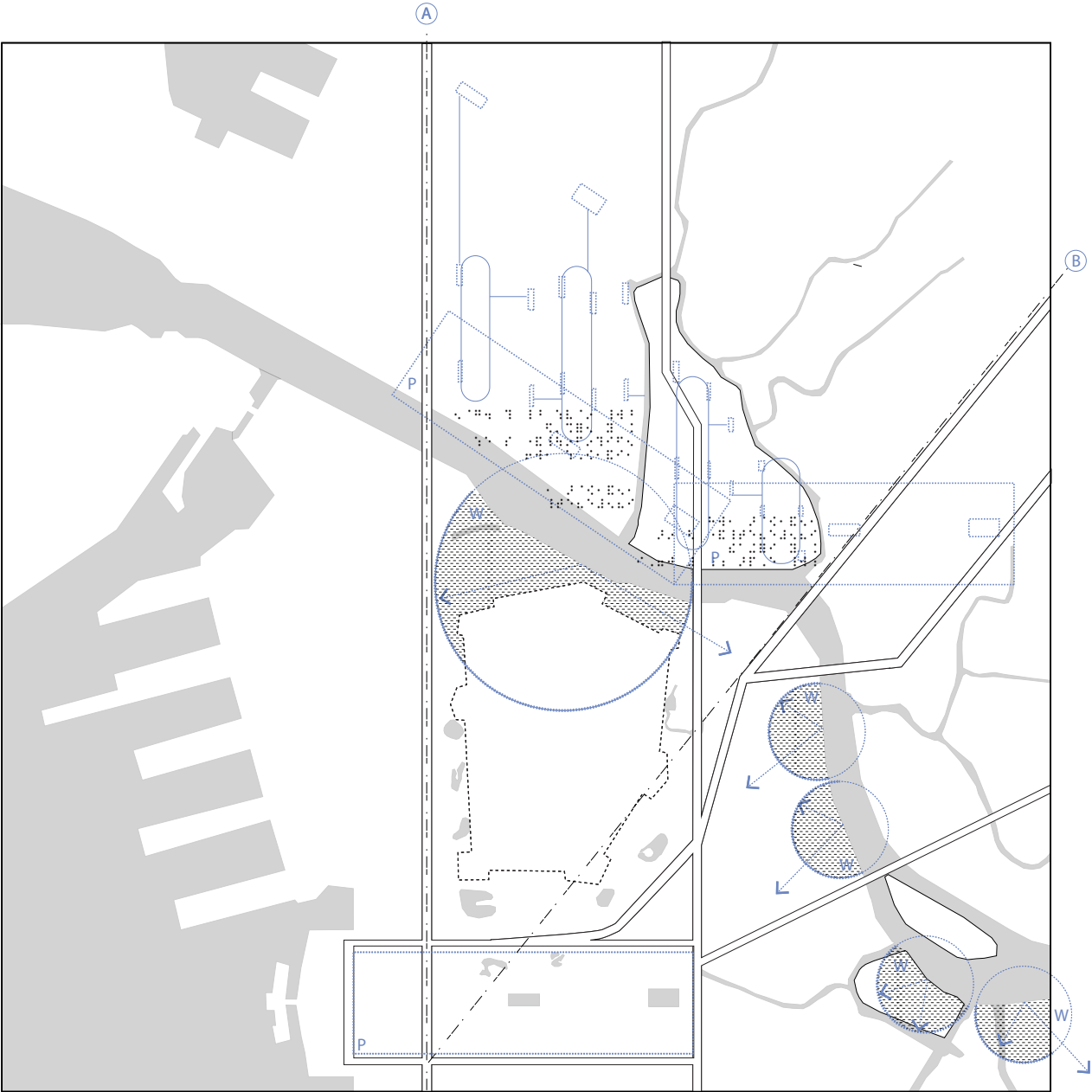


Figure 5-7 Early design strategy for historic site indicating initial ideas for flood adaptation

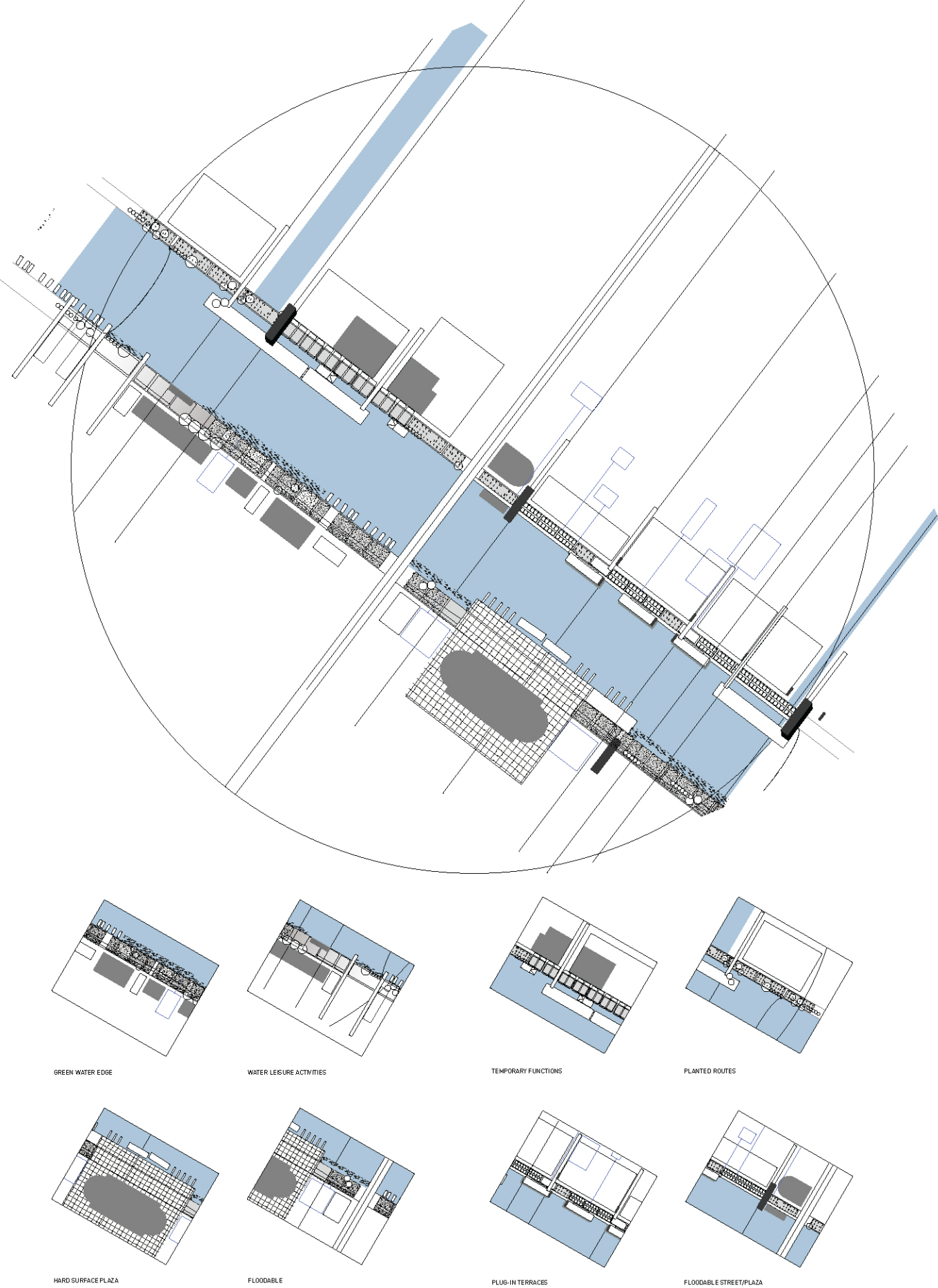


Figure 5-8 Early tactical designs in historic site indicating initial ideas for grey, green and soft adaptations

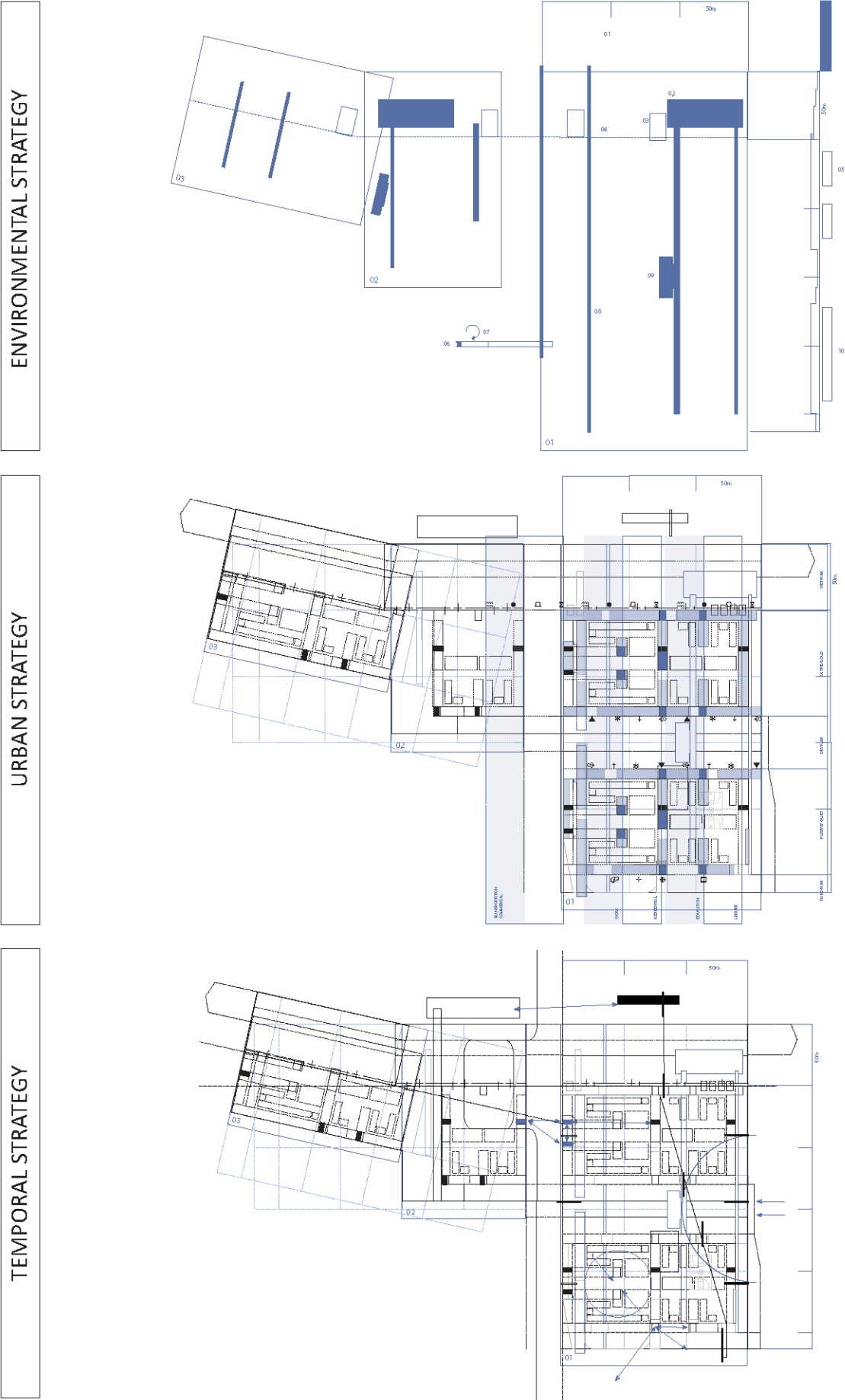


Figure 5-9 Early design strategy for post-industrial site indicating initial ideas for flood adaptation



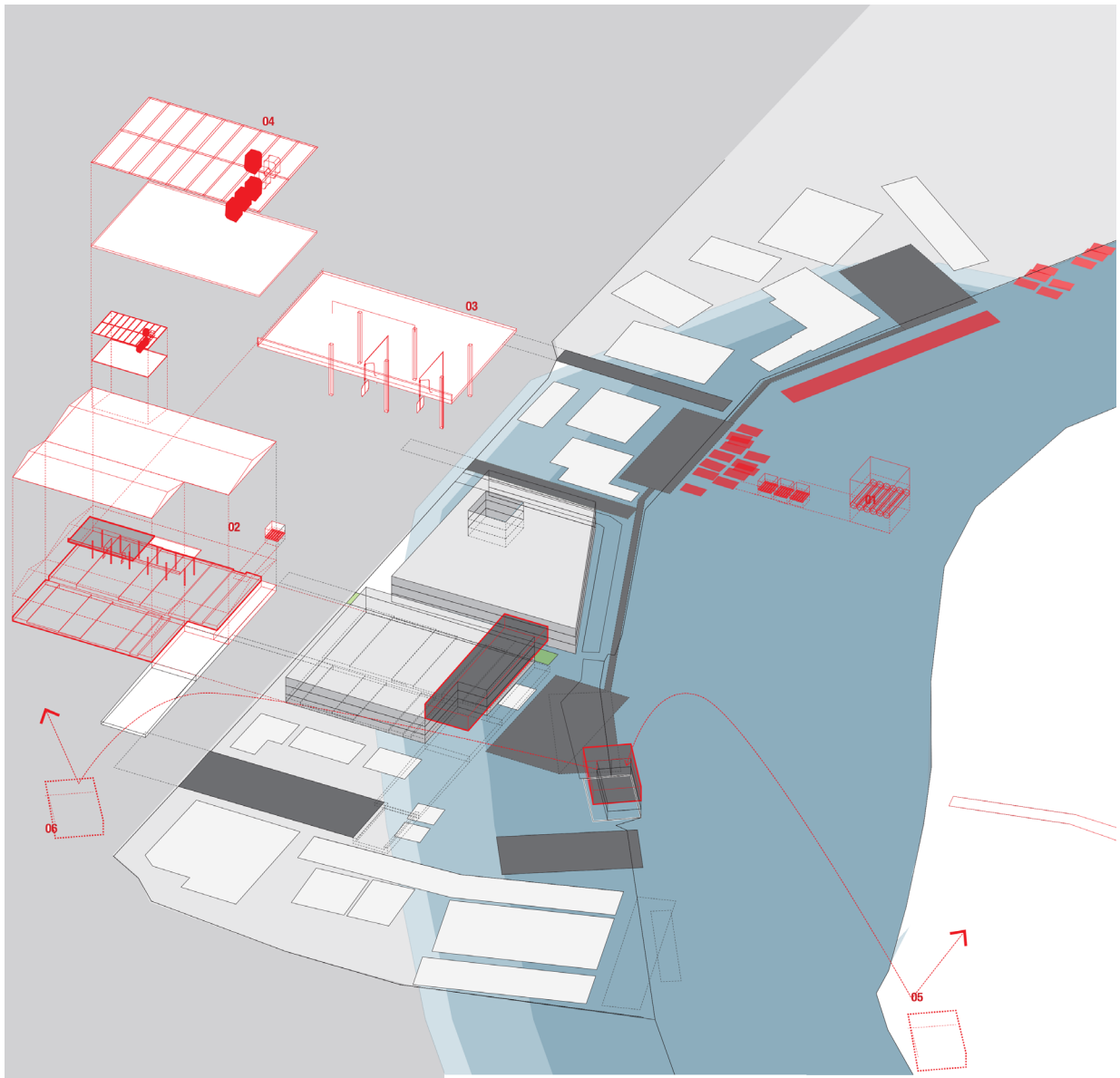
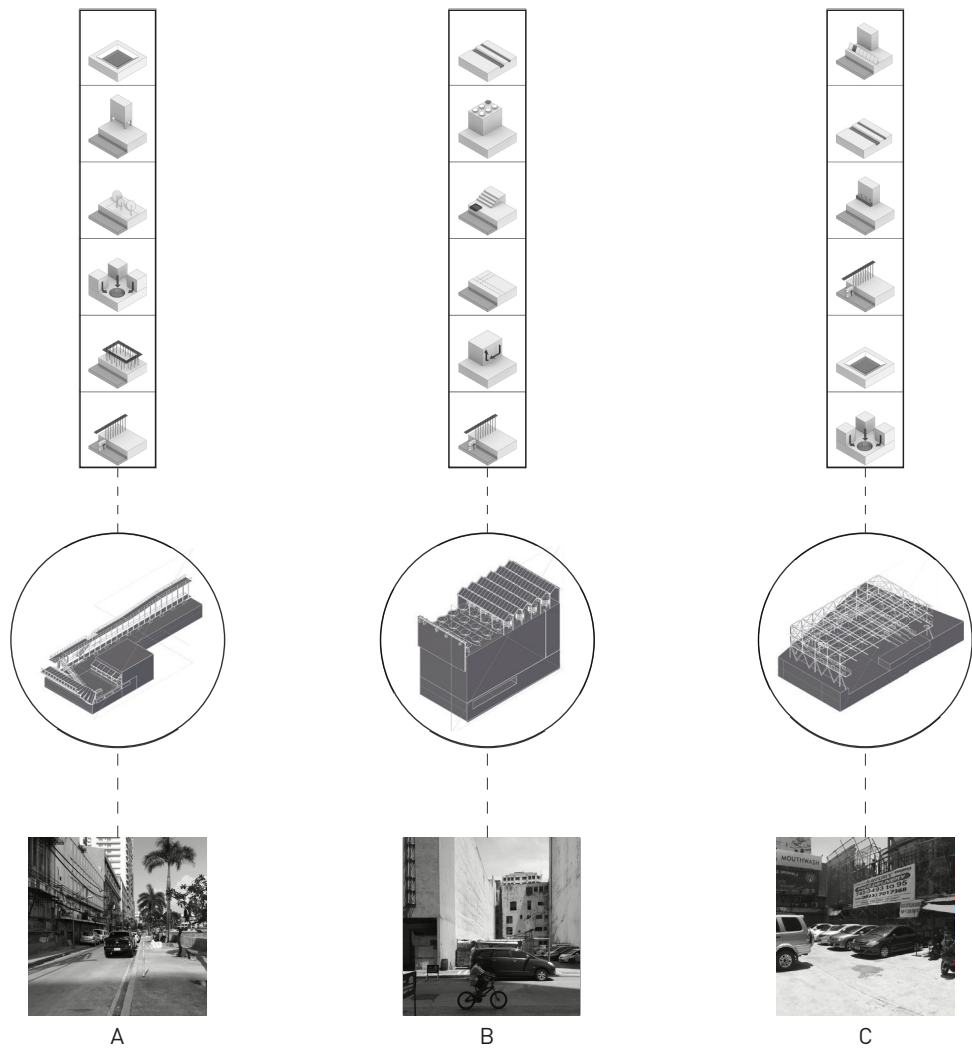


Figure 5-10 Early tactical designs in post-industrial site indicating initial ideas for grey, green and soft adaptations

TACTICAL INTERVENTION



STRATEGIC FRAMEWORK

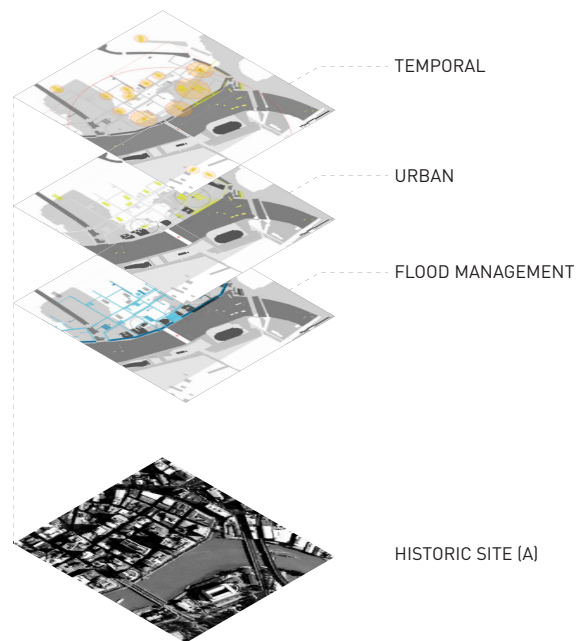
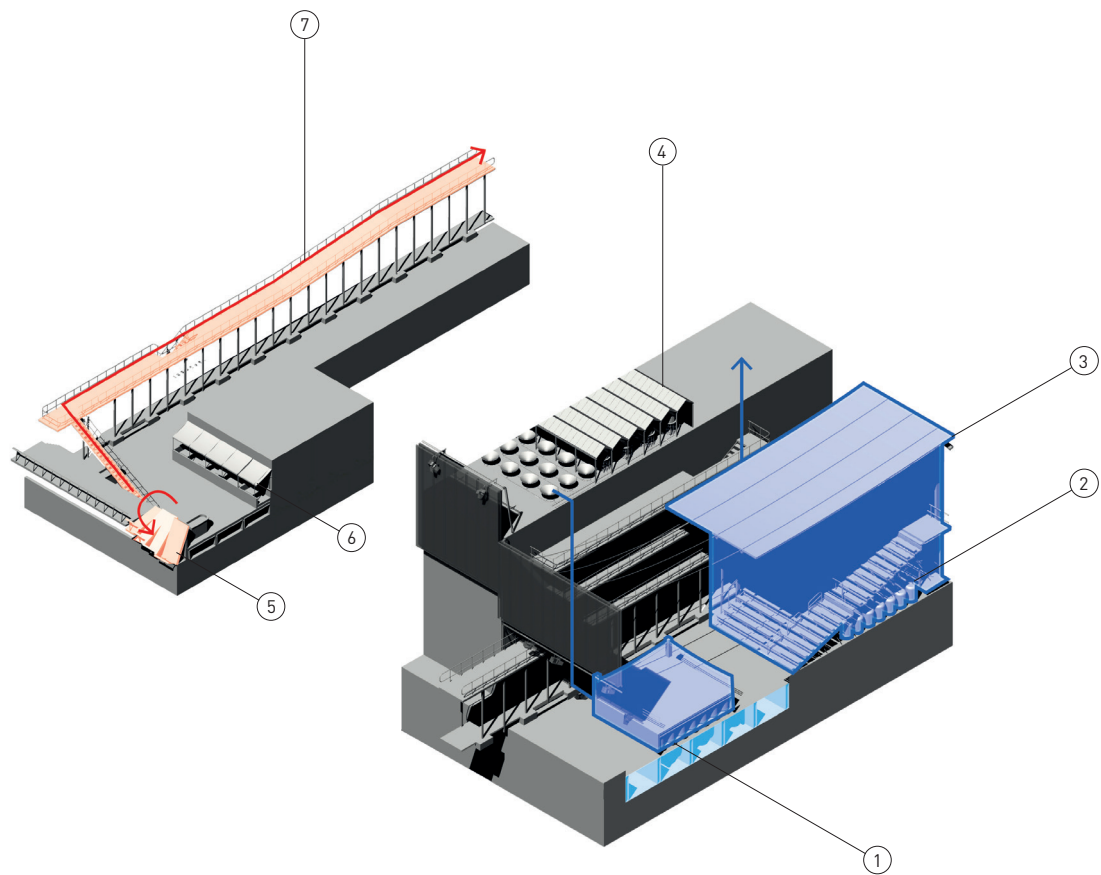


Figure 5-11 Developed design strategy and tactics for historic site indicating ideas for flood adaptation

---

 DIAGRAM OF SAMPLE INTERVENTIONS


## KEY

A - RIVEREDGE  
 B - VACANT LOT  
 C - HISTORIC PLAZA

1 - URBAN STAGE  
 2 - WATER STORAGE  
 3 - CANOPY  
 4 - RAINWATER COLLECTORS  
 5 - TEMPORARY FLOOD DEFENCE  
 6 - RAISED FLOOD TERRACES  
 7 - RAISED WALKWAY

## HISTORIC SITE (A)

Design interventions informed by the strategic framework set up for the historic neighbourhood and the particular urban characteristics. These result in terraces along the river edge, rainwater collectors on existing buildings and urban platforms covering water cisterns for the neighbourhood.

---

Figure 5-12 Developed spatial components in site indicating ideas for urban design



Figure 5-13 Flooding in Makati, South of Manila, on August 20, 2013. Image credit: AP Photo/Aaron Favila







Figure 5-14 Image of flooding to roof level August 7, 2012. Image credit: AP Photo/Mike Alquinto.





Figure 5-15 Marikina City, east of Manila, Philippines, on August 8, 2012. Image credit: AP Photo/Aaron Favila





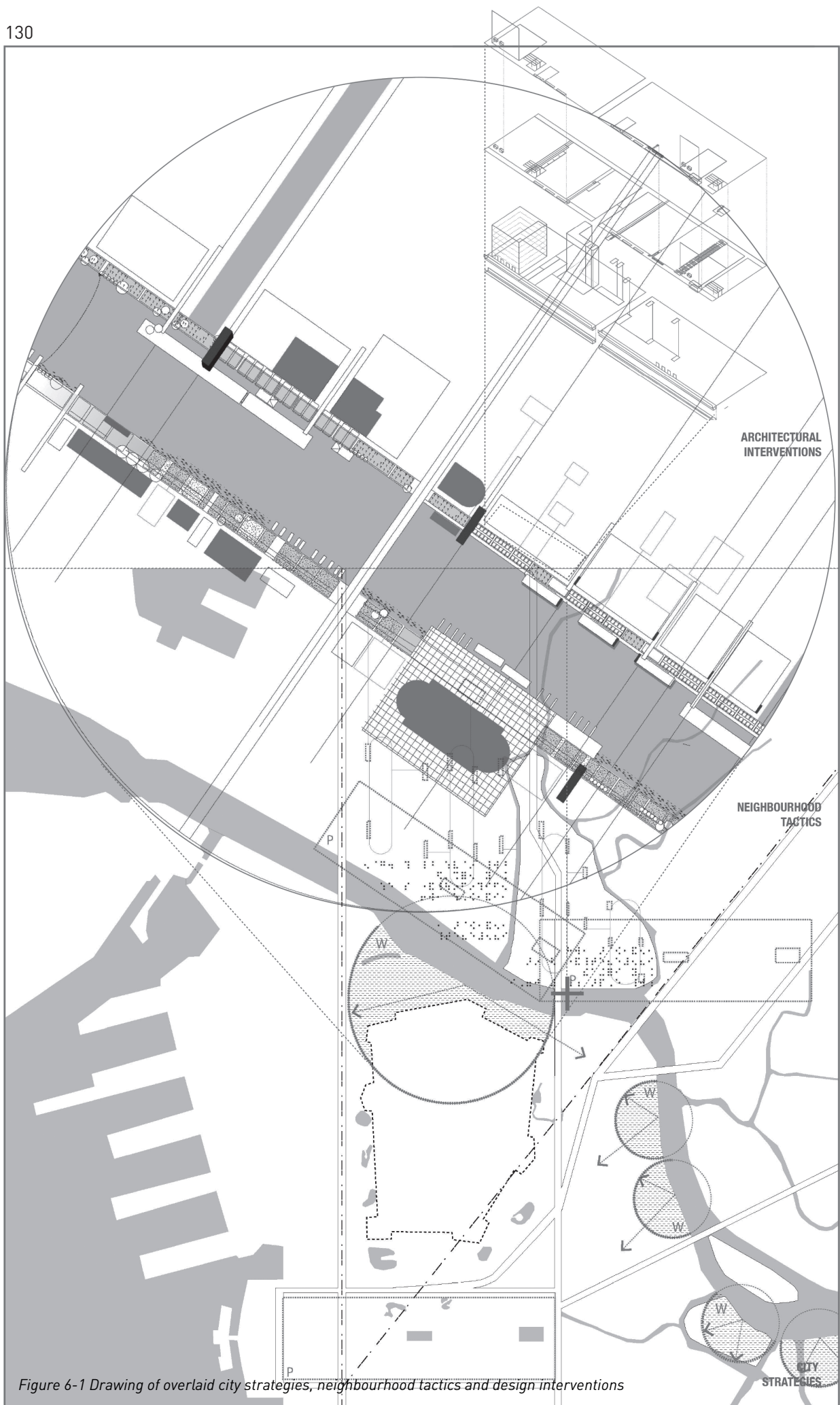


Figure 6-1 Drawing of overlaid city strategies, neighbourhood tactics and design interventions



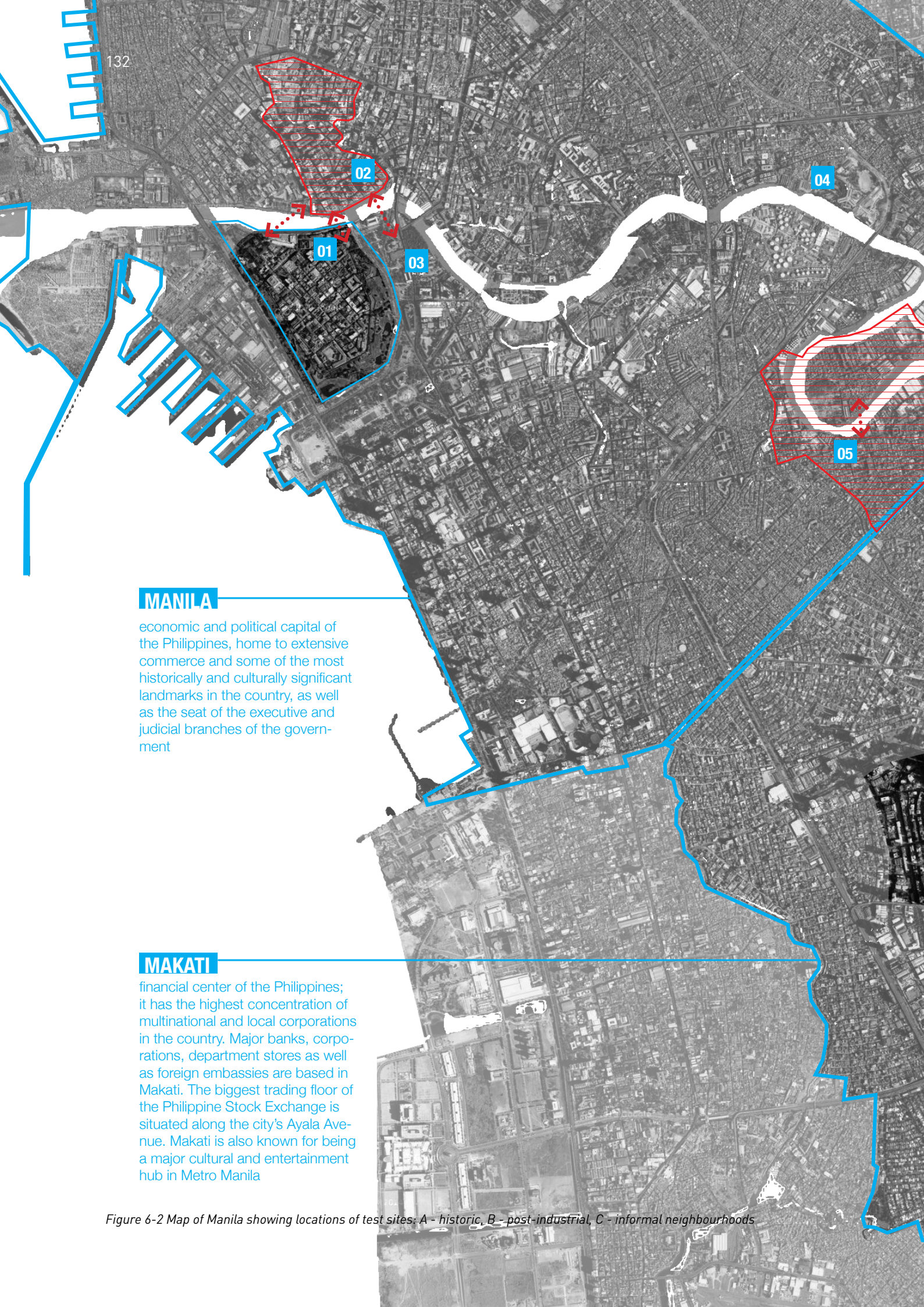
## Chapter 6: Interventions and Illustrations

The ambition to develop an ecological infrastructure for Manila's river edge was to create a balance between the presence of water and urban life. Key to the exploration of flood adaptation was the interdependence between design, environmental functions and local inhabitation, but also the question of connectivity. How would the design interventions keep the neighbourhood physically connected during flood season? What additional benefits would such adaptations provide during dry times? How could design interventions connect over time to become part of an incremental flood-adaptive network?

The project developed speculative yet plausible scenarios for three sites: historic and post-industrial and informal neighbourhoods. The different settings were used as the testing ground for the design strategies and tactics developed in the previous chapter. To develop an appropriate response for each site, the design proposals were considered in relation to the specific urban grain, local flood management practice, governance and the community's economic capacity. The designs identified typical conditions for intervention and were tested iteratively through two and three-dimensional drawings to explore their spatial implications. The designs first considered the extent of flooding and the urban context of each site, which together with the universal flood management catalogue (refer to end of Chapter 4), informed the strategic flood management design. In a second step, a number of tactical components were identified and overlaid with the flood management strategy. The tactical interventions were constructed from the catalogue of spatial components (refer to section 5.3.2) to respond to the specific environmental and urban conditions of each particular site.

The design studies considered the interventions in terms of scale and time, and the sequence of illustrations in this chapter describe the systematic interrogation for each site. They describe the project in the following order: (1) Flood risk, (2) urban character, (3) strategic plan (4) tactical interventions (5) spatial locations. Typical sites for intervention were identified for each site (6) and their spatial implications are described through (7) axonometric diagrams and (8) birds eye view perspectives. A set of layered collages at the end of Chapter seven suggests what the interventions might provide to the neighbourhood at ground level. The drawings reflect a combination of research into precedents of flood adaptation, as well as intuitive responses to each local condition.





## MANILA

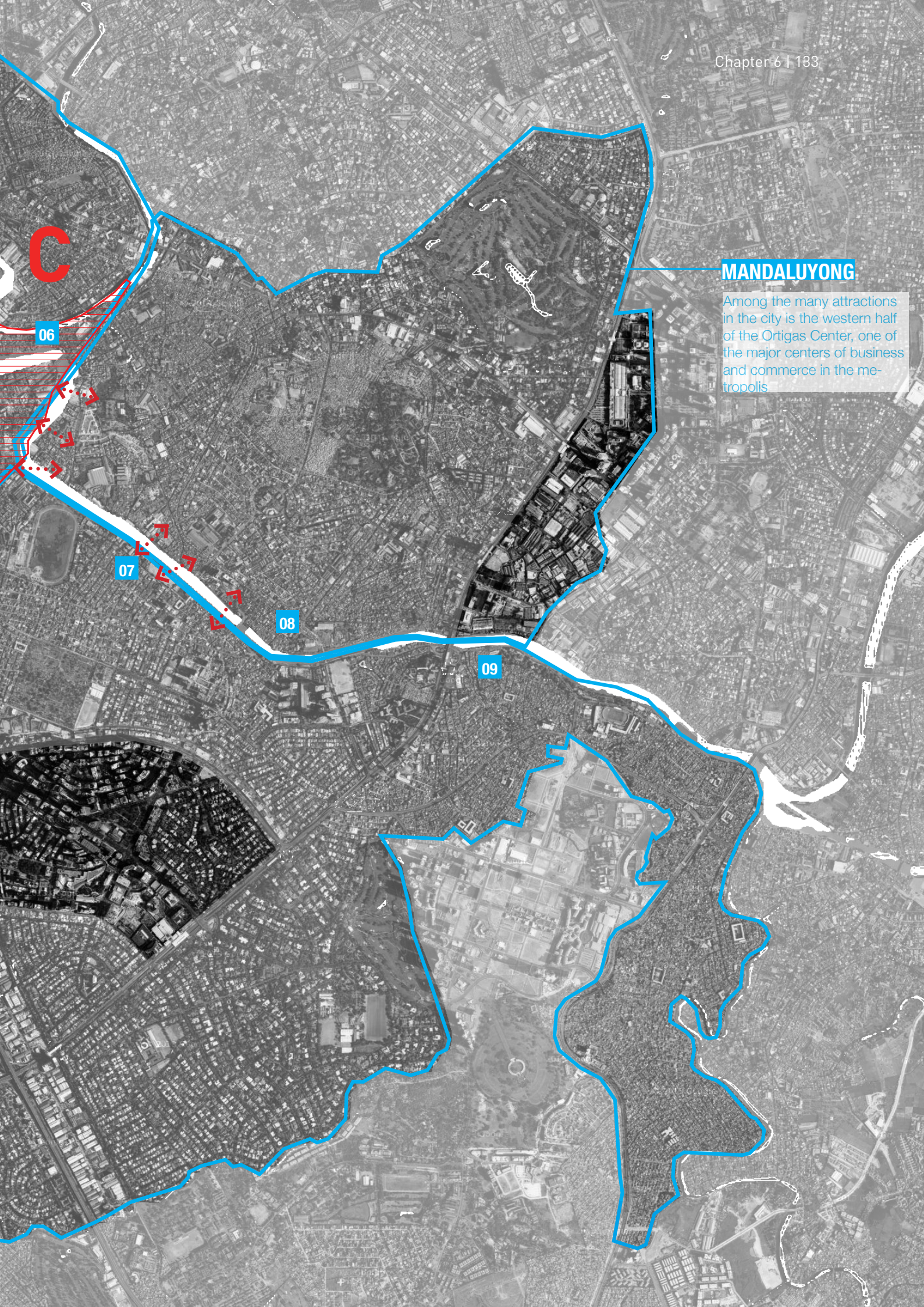
economic and political capital of the Philippines, home to extensive commerce and some of the most historically and culturally significant landmarks in the country, as well as the seat of the executive and judicial branches of the government

## MAKATI

financial center of the Philippines; it has the highest concentration of multinational and local corporations in the country. Major banks, corporations, department stores as well as foreign embassies are based in Makati. The biggest trading floor of the Philippine Stock Exchange is situated along the city's Ayala Avenue. Makati is also known for being a major cultural and entertainment hub in Metro Manila

Figure 6-2 Map of Manila showing locations of test sites: A - historic, B - post-industrial, C - informal neighbourhoods





## MANDALUYONG

Among the many attractions in the city is the western half of the Ortigas Center, one of the major centers of business and commerce in the metropolis



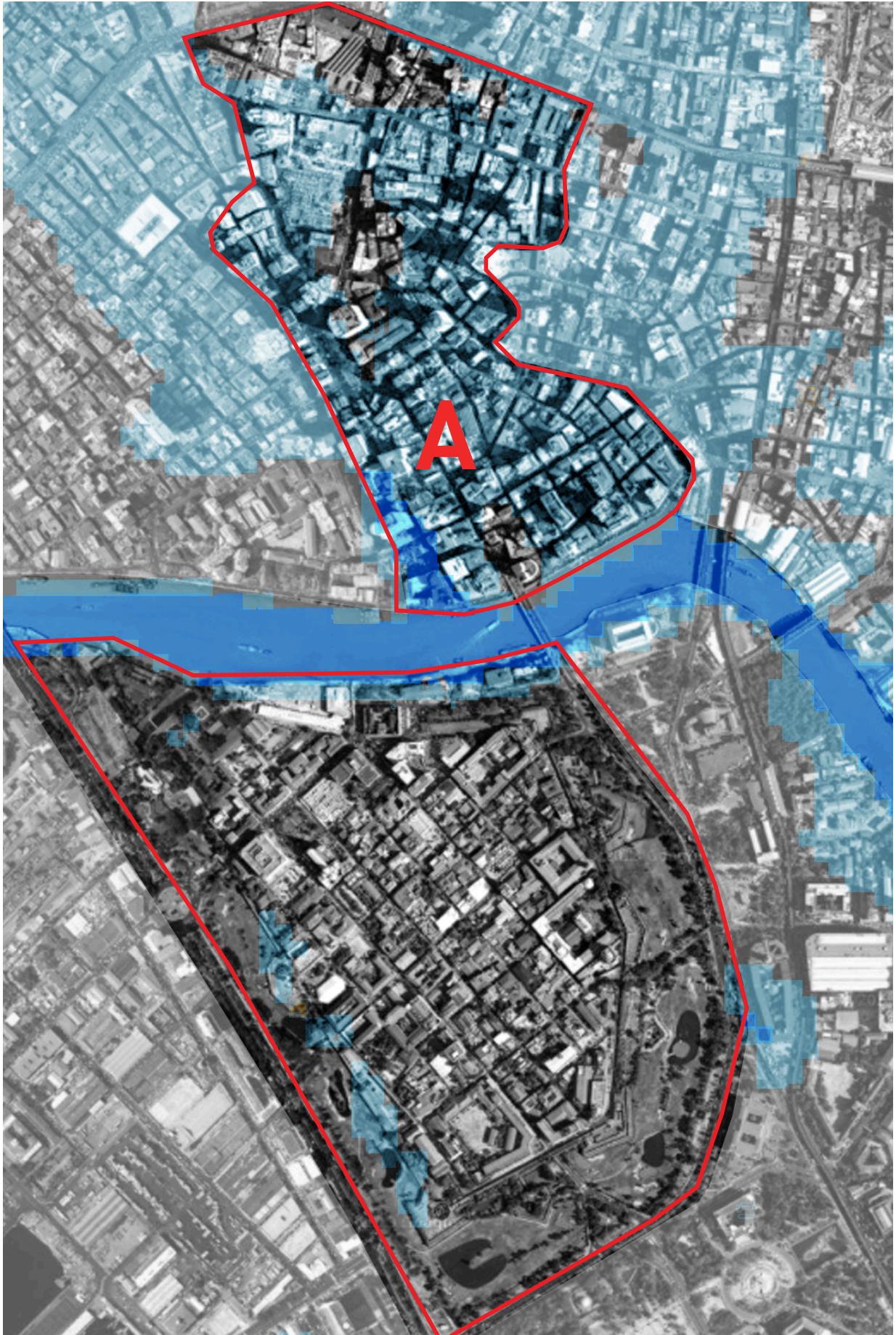


Figure 6-3 Satellite view of historic site (A) to the north





Figure 6-4 Satellite view of post-industrial neighbourhood (B) to the south and informal settlement (C) to the north





Figure 6-5 Elevation of Binondo - historic site A

## 6.1 Binondo - Historic Site as Testing Ground for 'Surface' Interventions

The first site, Binondo (Site A), is located at the lower catchment of the Pasig River. The site lies north of the river facing Manila's historic walled city Intramuros, and as a former commercial centre of the city still shows signs of a long history of river trade. As much of this neighbourhood was destroyed during the Second World War, Binondo's urban fabric has fallen to neglect, characterised by vacant lots, decaying buildings and historic plazas that today serve as impromptu parking lots. The neighbourhood's relation to the Pasig has been blocked off through recently constructed floodwalls, transforming a historically active riverfront into an underused service road. Today, Binondo's strategic proximity to the city's historic core to the south and Manila's Chinatown to the north are attracting renewed interest for regeneration through cultural heritage conservation and private economic development (Guéguen 2010). This transition is visible in the development of luxury condominium buildings that, driven by the private real estate market (Guéguen 2010), are slowly replacing Binondo's traditional shop-houses.

The design strategy consists of retrofitting the neighbourhood's overlooked open spaces. Starting with a series of 'surface' interventions the project explores how to transform the river edge and the neighbourhood's pockets and plazas into flood adaptive spaces. These are further enhanced through a range of small-scale building interventions and connections that transform the neighbourhood into a flood-resilient system. The systematic mapping of Binondo brought the dominant environmental and urban forces to the foreground. In a first step, the analysis highlighted the main areas at flood risk, which was later compared with the neighbourhood's projected development patterns.

The underlying objective of this process was to examine the site's physical connectivity during flood events. Instrumental for the study were conversations held with a river engineering consultant Gatterell (2016) highlighting the distinction between the particular fluvial/pluvial water patterns and establishing a nuanced flood management sequence. A split flood management approach was suggested: to maintain the floodwalls to deal with the initial threat from river flash floods, and to develop an adaptive strategy to slow down the overflow from pluvial flooding.

The design study began by reconfiguring the river edge and explored ways of pedestrianizing the riverfront and creating stepped platforms along the floodwall. This terracing suggested

new ways of activating the riverfront offering views to the other side of the river and transforming the service road back into a river promenade. Along the river edge a new eco-systemic layer was proposed as a network of green buffers, porous streets and catchment basins, all capable of absorbing and redistributing floodwater. For example, a combination of cast concrete meshes and a choice of local planting, capable of withstanding the pressures of polluted floodwater, would replace the hard paving of existing service roads and introduce new degrees of porosity. At the same time, 'green streets' running perpendicular to the line of the Pasig, would act as a sponge and become part of the water management system designed to capture seasonal water overflows. Such surface interventions would not only perform environmental functions of managing floodwater, but also create new opportunities to transform the neighbourhood's microclimate and overall urban experience.

In a further step, other surface interventions were proposed for Binondo's pockets and plazas to deal with the city's pluvial water overflows. Potential sites for intervention within the historic neighbourhood were identified through satellite imagery and onsite field studies. Research into Manila's historic urban fabric showed how the rise of trade and new commercial centres to the northern part of the historic district has led to the economic decline in parts of neighbourhood (Alcazaren 2016). As a result, much of the historic fabric has been left in disrepair with an array of vacant lots awaiting new investment. Systems of urban rainwater harvesting were introduced into these sites as a means of source control that would reduce the amount of water reaching the existing drainage systems.

Other significant sites of intervention are Manila's former plazas – the city's traditional open spaces – which once played the central role its urban life. Today these are being turned into parking lots or disappearing altogether (Alcazaren 2016). The study proposed to convert the plazas into floodwater basins, which not only would charge them with renewed ~~function and~~ <sup>function and</sup> meaning, but also reconnect the spaces with the institutional landmark buildings that once defined them. In order maintain the water systems, small building interventions were proposed to cover the vacant lots and plazas, ranging from simple rainwater gardens to recreational shelters to promote cultural and recreational activities.

To effectively reduce flood risk through the introduction of permeable ground is of course a question of scale. With predicted flood depths at knee- to waist-height, the amount of vacant space available to store water proved to be insufficient to adequately lower the neighbourhood's flood levels. The area for permeable surfaces needed to extend beyond the

horizontal ground plane. Therefore, in addition to water management at ground level the design study proposed to target pluvial flooding at source by capturing, channelling and storing rainwater starting at roof level. This additional surface area would be linked to the network of plazas, vacant lots and smaller rainwater gardens to increase the neighbourhood's overall capacity to absorb water. The accumulation of such smaller interventions would not only contribute to delay, store and release storm water to prevent urban inundation, but also function as water reservoirs that could feed back into the neighbourhood's everyday grey water functions inside buildings, in the cleaning of public streets and places, and in the irrigation of the network of urban parks. From an environmental perspective, this network of smaller green/blue water gardens would increase the city's overall green footprint (Ecotech 2016).

At a neighbourhood scale, the strategy of retrofitting explored how one could replicate natural drainage patterns, which could collect, store and potentially clean flood water (SUDS) before it were to be released back to the Pasig, once river flood levels had subsided. The proposal to reintroduce permeable surfaces and water harvesting practices is therefore not to be mistaken for a nostalgic revisiting of past histories, but as a necessary restructuring of the urban ground to prepare for Binondo's future.

The tactical nature of the different types of water systems could start small; connected and grown they would have the potential to have big and impactful outcomes when a multitude of these actions would be taken. The interventions could start as small as the design of rainwater tanks, but also cover wider areas – by increasing the area of permeable surfaces in the neighbourhood, opening up covered waterways and creating local water squares.

Collectively, such forms of sustainable local water management would not only help with local flood control, but also decrease the stress on existing centralised water infrastructure through sustainable local water resourcing. Tested within the historic city fabric, the variety of surface components suggests a number of organic solutions toward water sensitive development. As modular, flexible and replicable design elements, they could also systematically be developed and applied to other sites in the city.



#### SATELLITE VIEW & FLOOD MAP HISTORIC SITE (A)

Top  
Satellite view of historic quarter.  
Neighbourhood of Binondo located to the north.

Right  
Indicative floodmap showing extent of flooding based on 25 year flood hazard maps with an approximate flood height of +0.5m.

Source: Project Noah (<http://noah.up.edu.ph>)

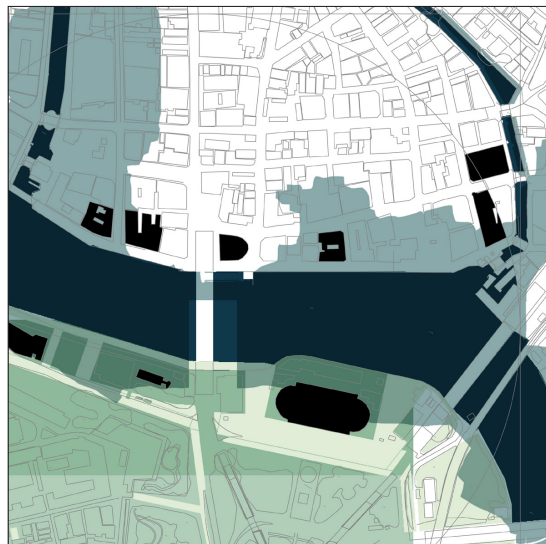
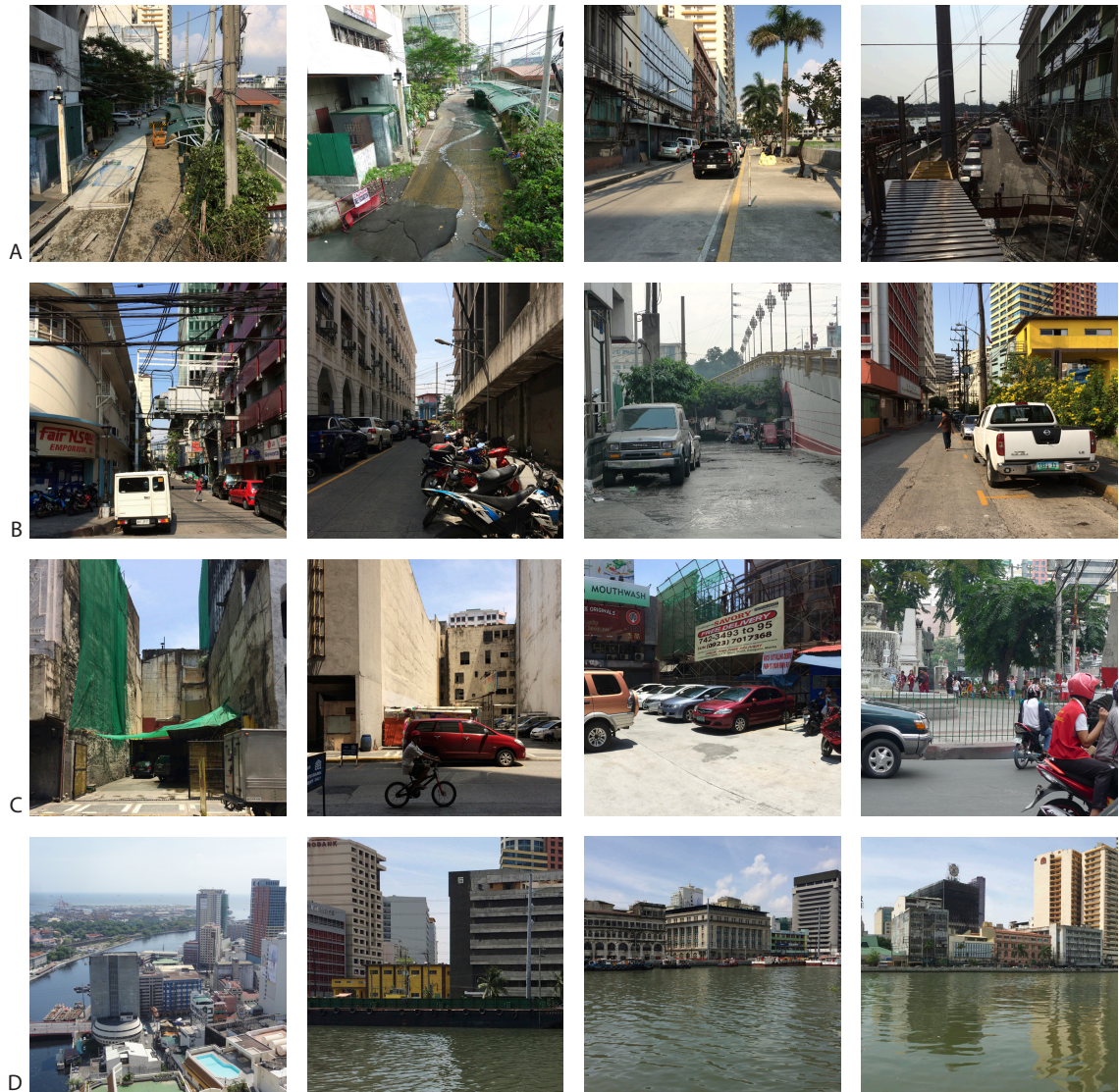


Illustration 6-1 Historic site overview





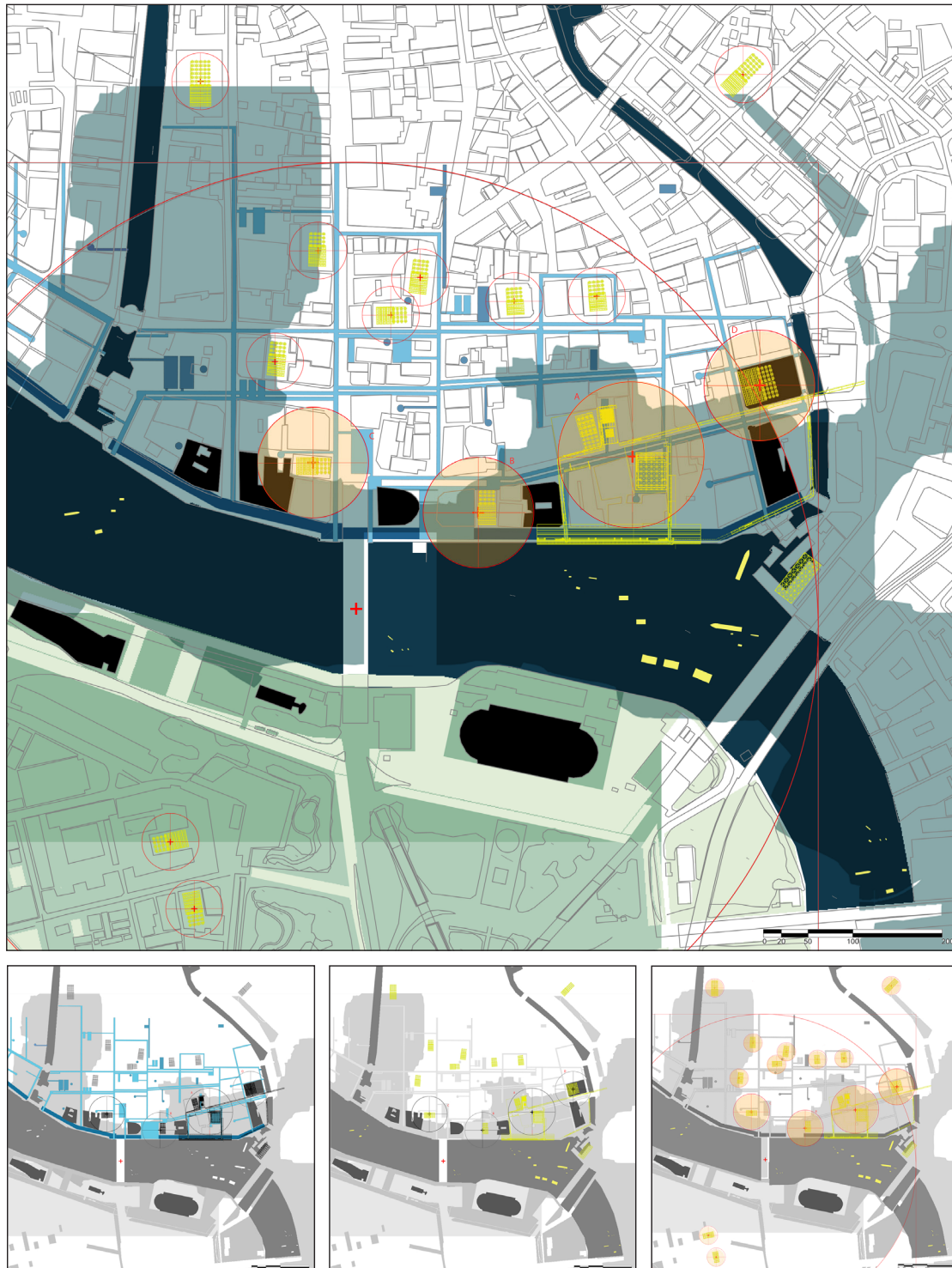
#### URBAN CHARACTERISTICS HISTORIC SITE (A)

- A - Edge
- B - Paths
- C - Space typologies
- D - Details

- Edge: Riveredge used as service road. Riveredge protected by concrete flood walls
- Paths: Streets perpendicular to the river used as side streets and parking areas
- Space: Numerous unoccupied parking lots and historic plazas repurposed as parking lots
- Details: Area defined by underused flat roofs, pumping stations and buildings of historic significance.

Illustration 6-2 Historic site photographs





#### STRATEGIES HISTORIC SITE (A)

##### FLOOD MANAGEMENT

The neighbourhood is protected from fluvial flood risk through flood walls. The permeability of Binondo's streets is increased through the introduction of blue/green channels. Rooftops are connected to a new network of water harvesting.

##### URBAN FRAMEWORK

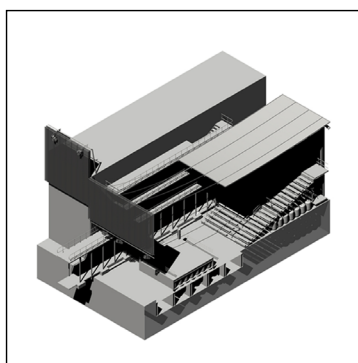
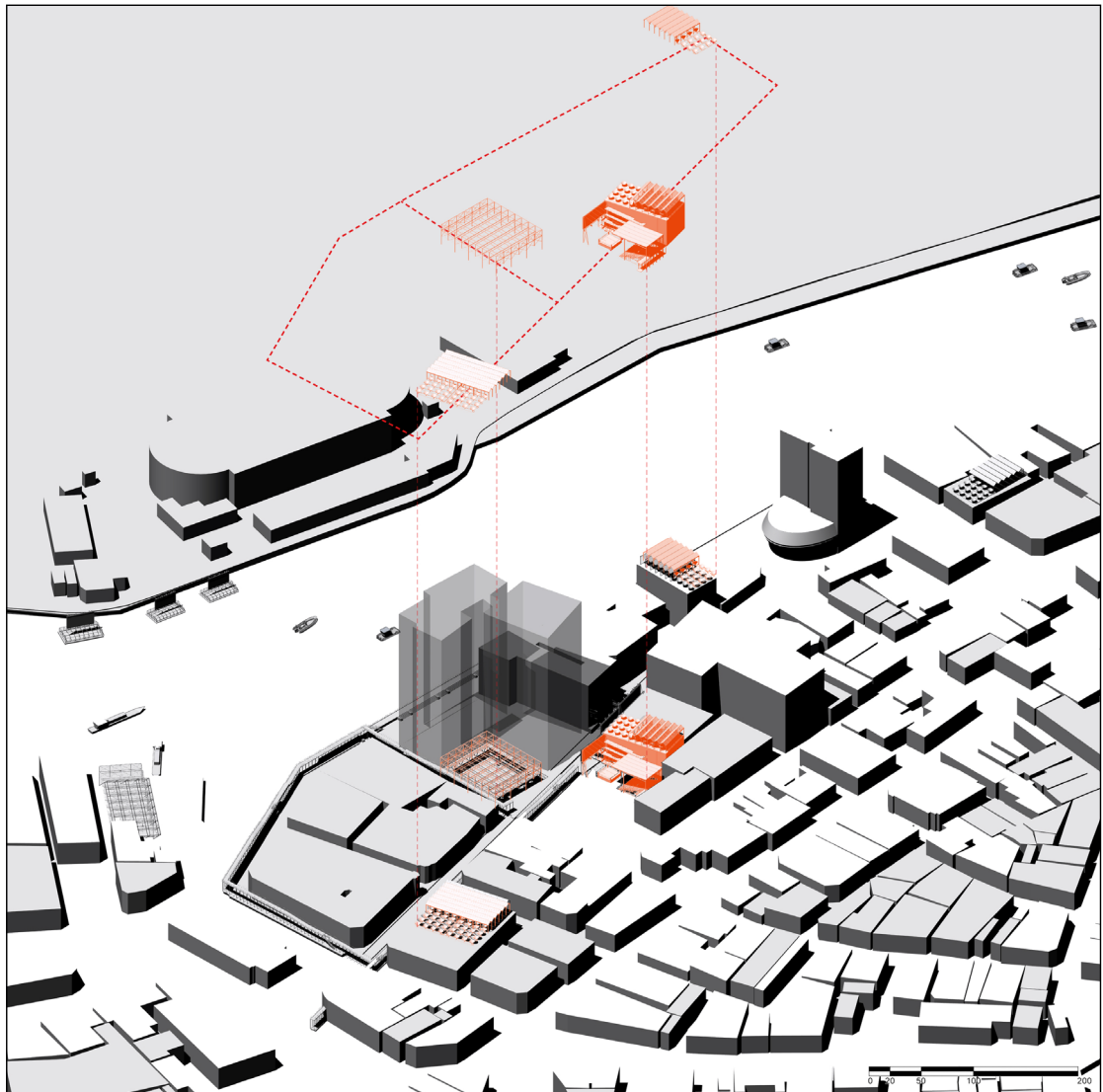
The riveredge is converted into a river promenade. Terraces and landscaping are introduced to activate the river front and open buildings up toward the river. Urban platforms are introduced into vacant lots and historic plazas, which create new forms of public space.

##### TEMPORAL FRAMEWORK

The rainwater harvesting system and urban platforms are grown over time. The development of public squares and the promenade on the south side of the river create a connection between Binondo to the north and the historic quarter of Intramuros to the south.

Illustration 6-3 Site A Plan of historic neighbourhood showing 'retrofitting' strategy

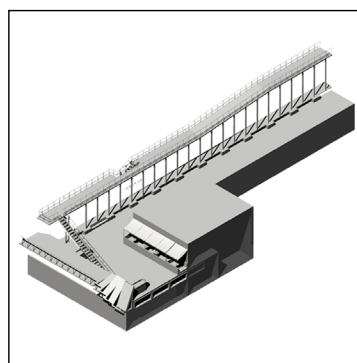




#### TACTICAL INTERVENTIONS HISTORIC SITE (A)

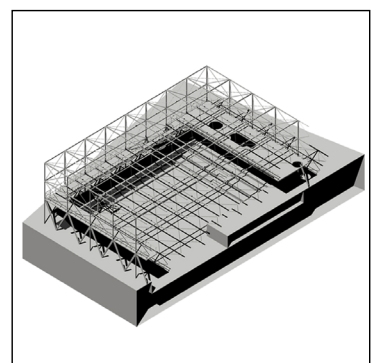
##### WATER RECYCLING

Rainwater collected from the roof is directed to water catchment system linked to the network of plazas, vacant lots and smaller rainwater gardens to increase the neighbourhood's overall capacity to absorb water.



##### WATER CHANNELING

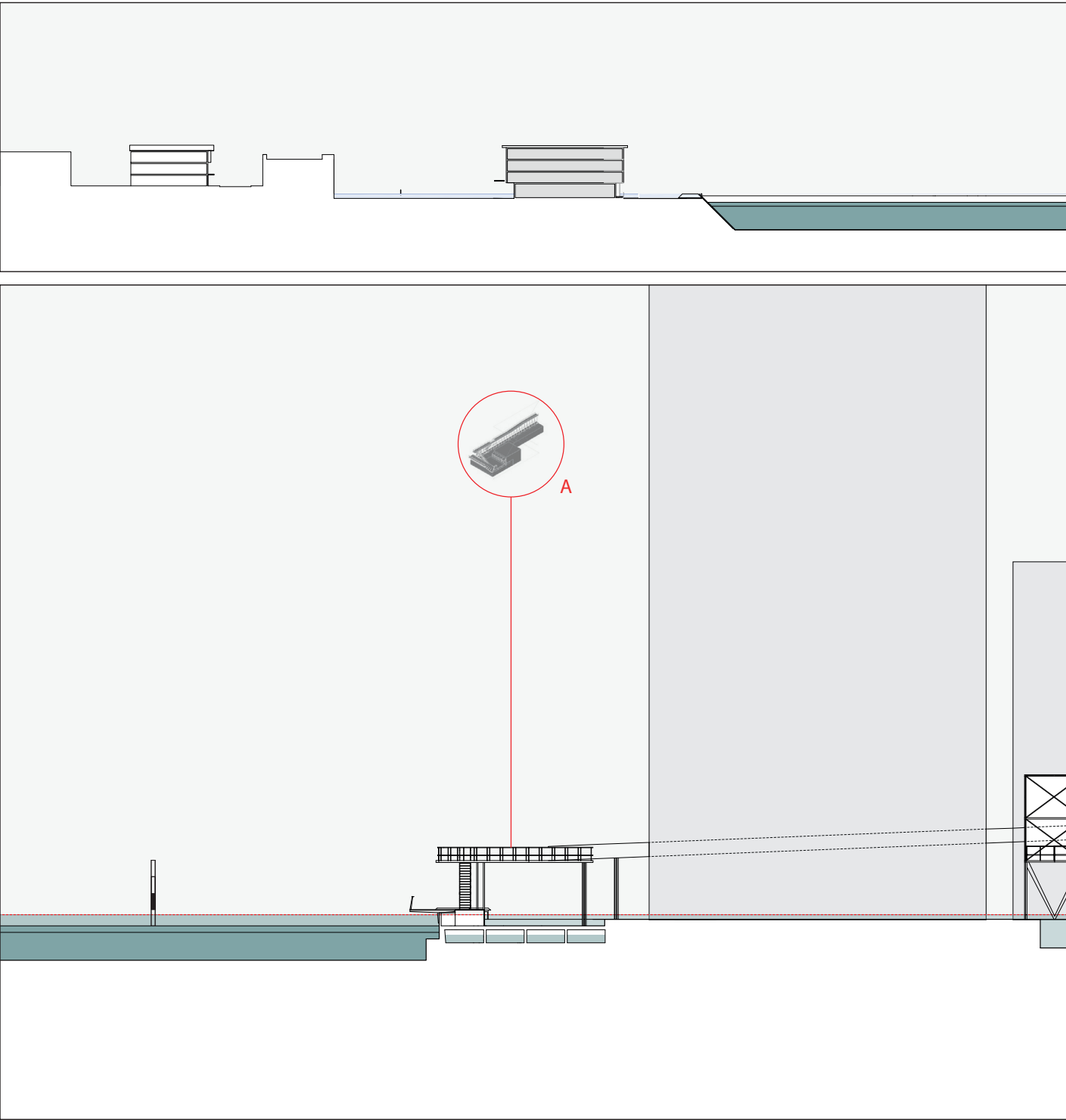
At a neighbourhood scale, the strategy of retrofitting explores how one could replicate natural drainage patterns, which could collect, store and potentially clean flood water before it is released back to the Pasig, once river flood levels has subsided.



##### WATER HARVESTING

To maintain the water systems, small building interventions are proposed to cover the vacant lots and plazas, ranging from simple rainwater gardens to recreational shelters to promote cultural and recreational activities.

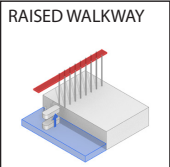
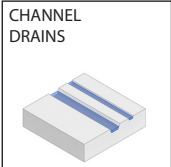
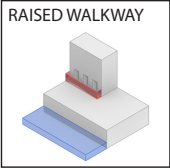
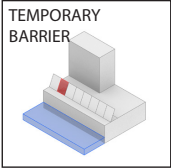
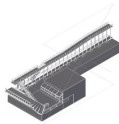
Illustration 6-4 Site A Axonometric of historic neighbourhood showing network of tactical interventions (Rain Collection/Harvesting, Raised Walkway, Covered Watersquare)



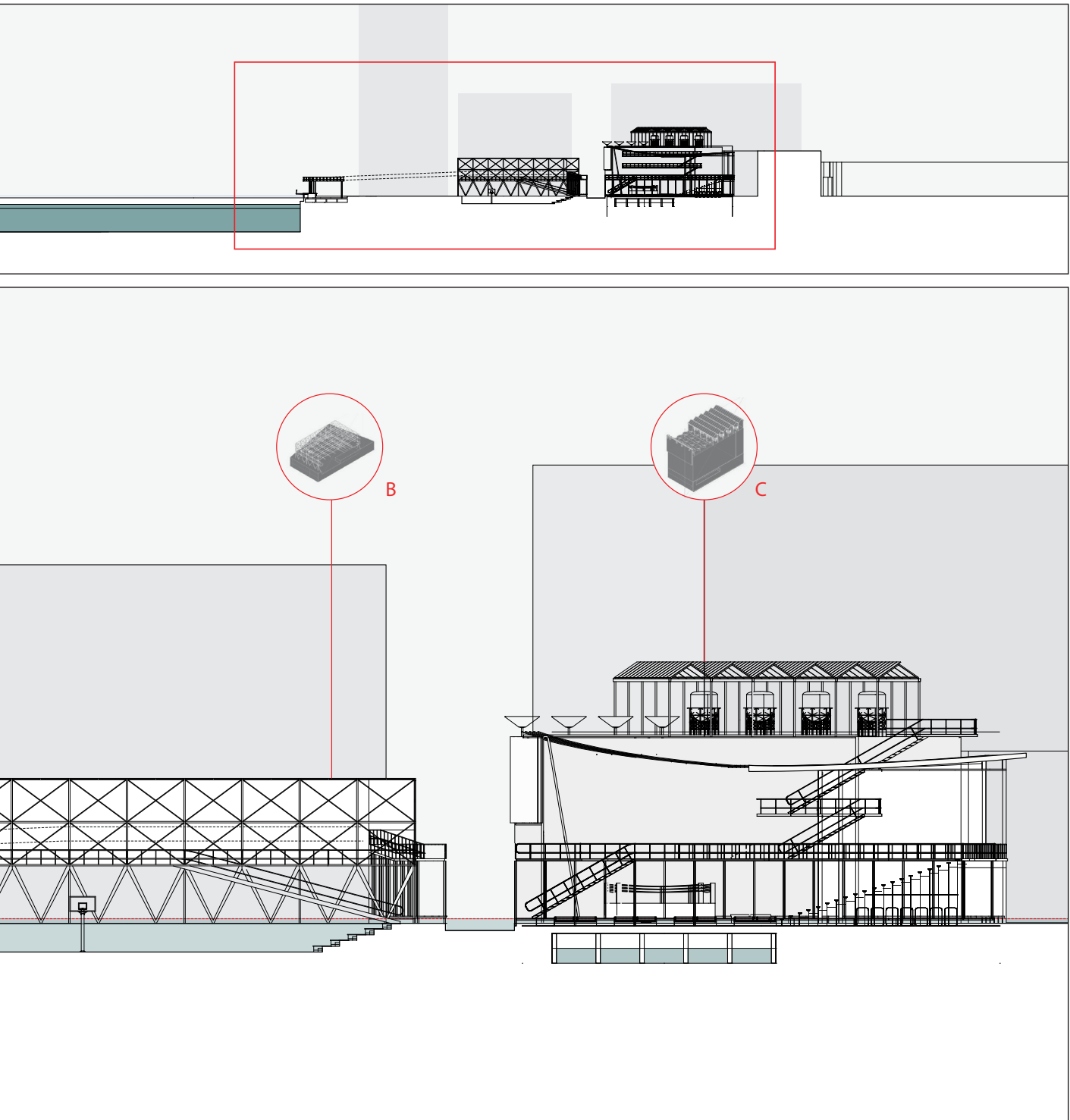
SPATIAL COMPONENTS  
SECTION THROUGH HISTORIC SITE (A)

- A - Riveredge with culverts
- B - Covered historic plaza and sunken court
- C - Urban platforms covering water cisterns

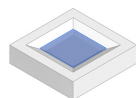
Illustration 6-5 Site A Section through historic neighbourhood showing combination of spatial components



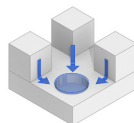




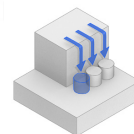
WATER SQUARES



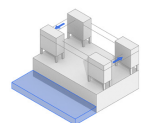
RAIN HARVESTING



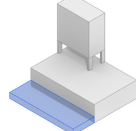
RAIN STORAGE



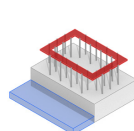
NETWORK



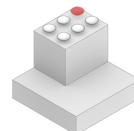
RAISED BUILDING



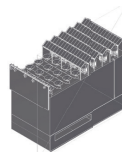
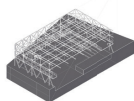
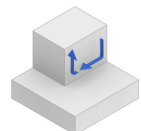
PATH

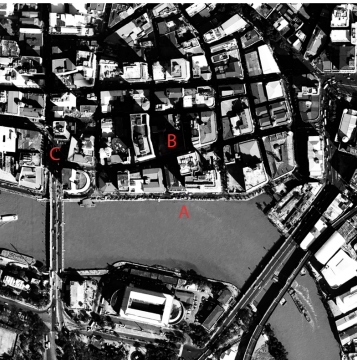


RAIN COLLECTION



WATER RECYCLING





LOCATION OF INTERVENTIONS  
HISTORIC SITE (A)

- A - River edge
- B - Typical vacant lot
- C - Historic plaza
- D - Underused rooftops

PERSPECTIVE 1  
HISTORIC SITE (A)

Perspective showing spatial intervention and historic neighbourhood.

- A - Black indicates area of surface interventions
- B - White indicates area of building interventions
- C - Orange indicates lines of connection

Illustration 6-6 Site A Photographs of historic neighbourhood showing typical locations of interventions

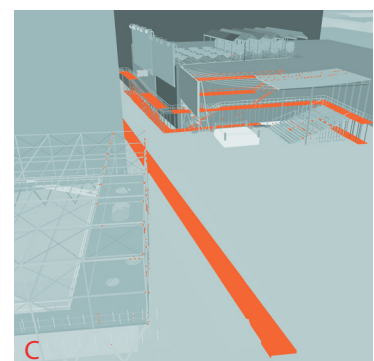
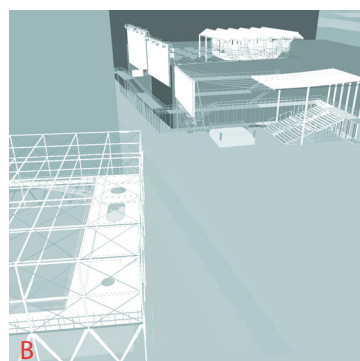
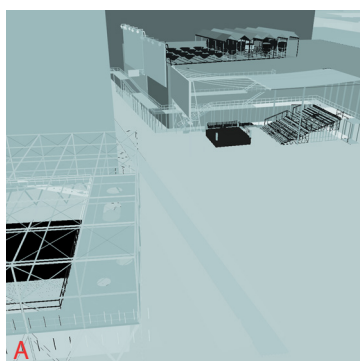
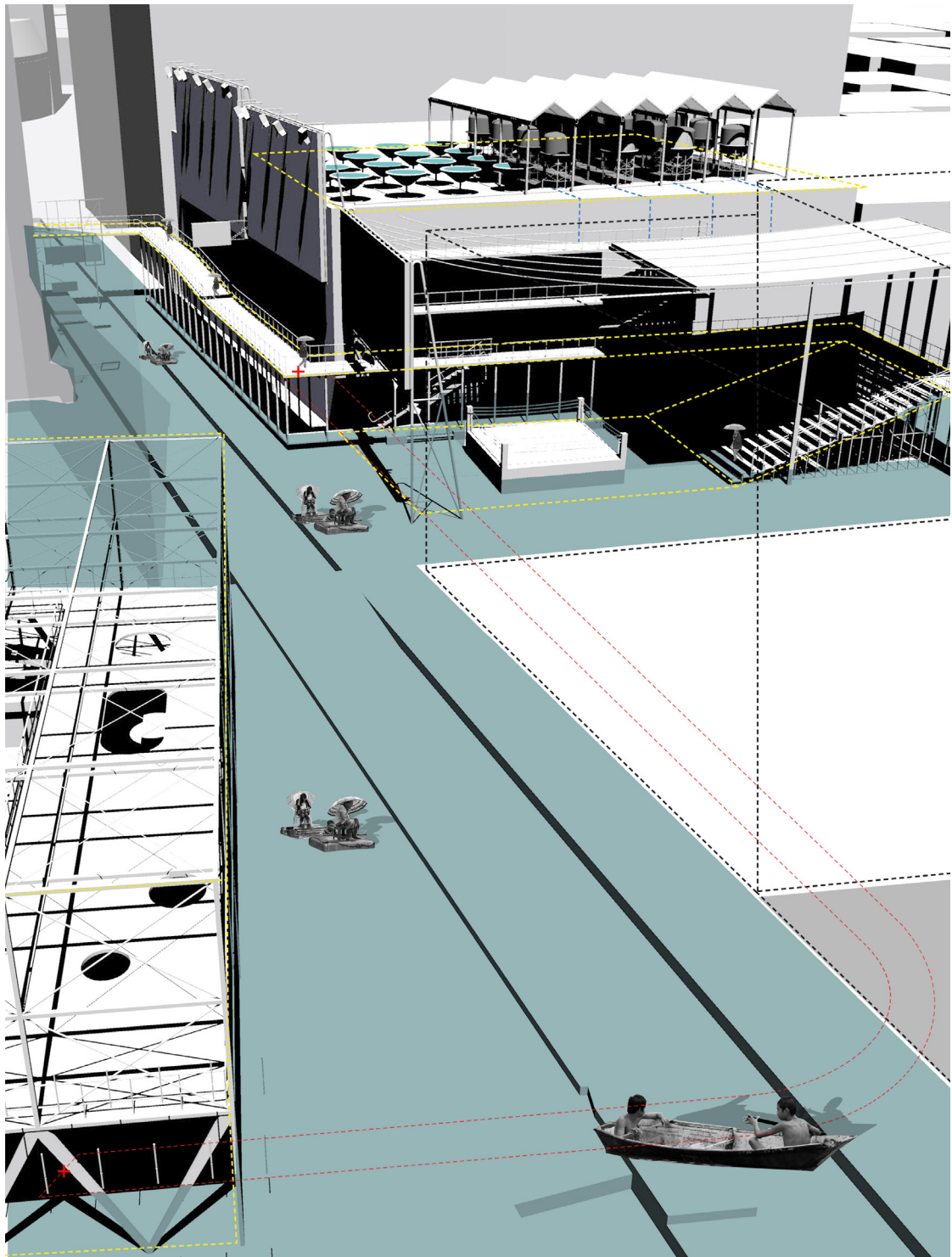
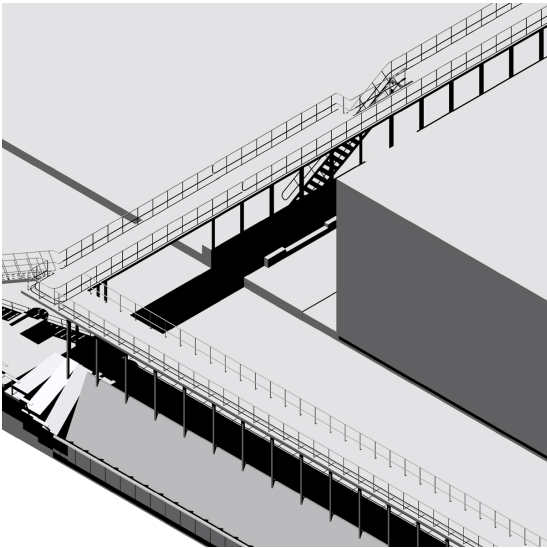
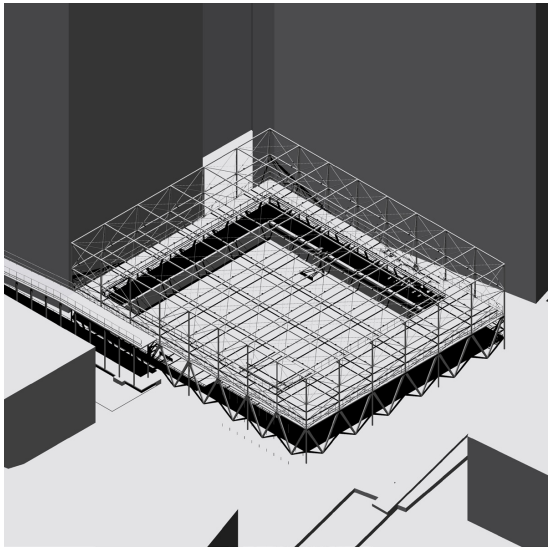


Illustration 6-7 Site A Perspective 1 of historic neighbourhood showing public stage and water collectors in vacant lot

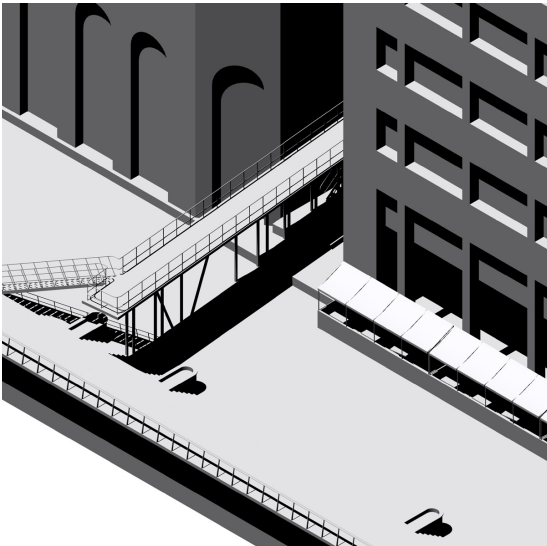




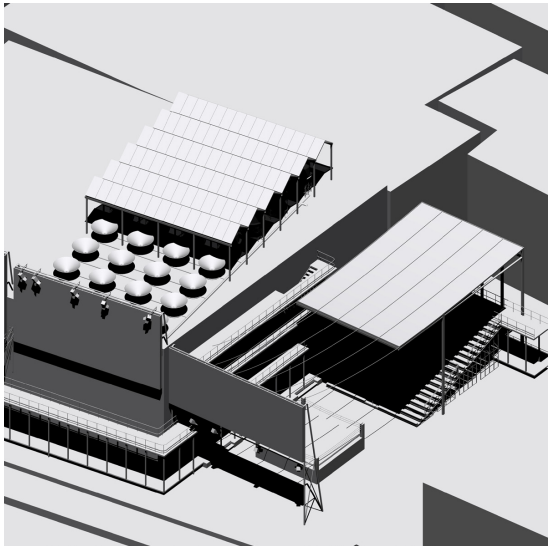
A



B



C



D

MOMENTS (TOP)  
HISTORIC SITE (A)

Typical spatial interventions

- A - Raised walkway
- B - Urban platform over historic square
- C - Urban terraces along riverfront
- D - Rainwater catchment and urban stage

PERSPECTIVE 2 (RIGHT)

View of covered historic square  
and sunken courtyard

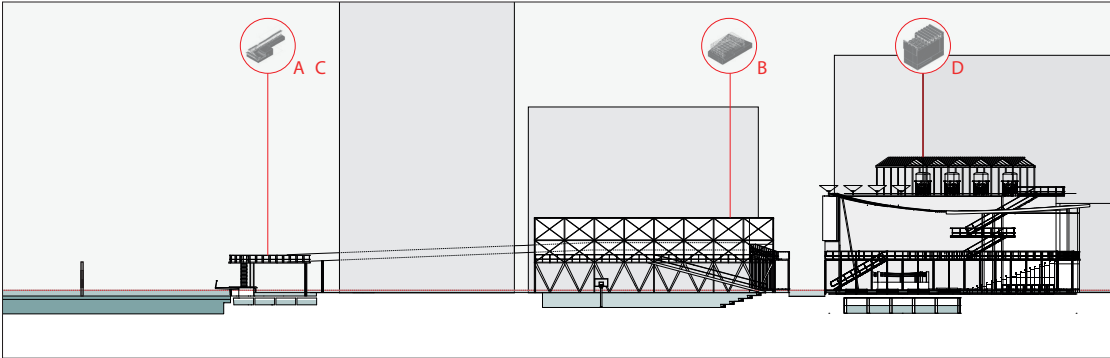


Illustration 6-8 Site A Moments in historic neighbourhood showing tactical interventions in typical locations



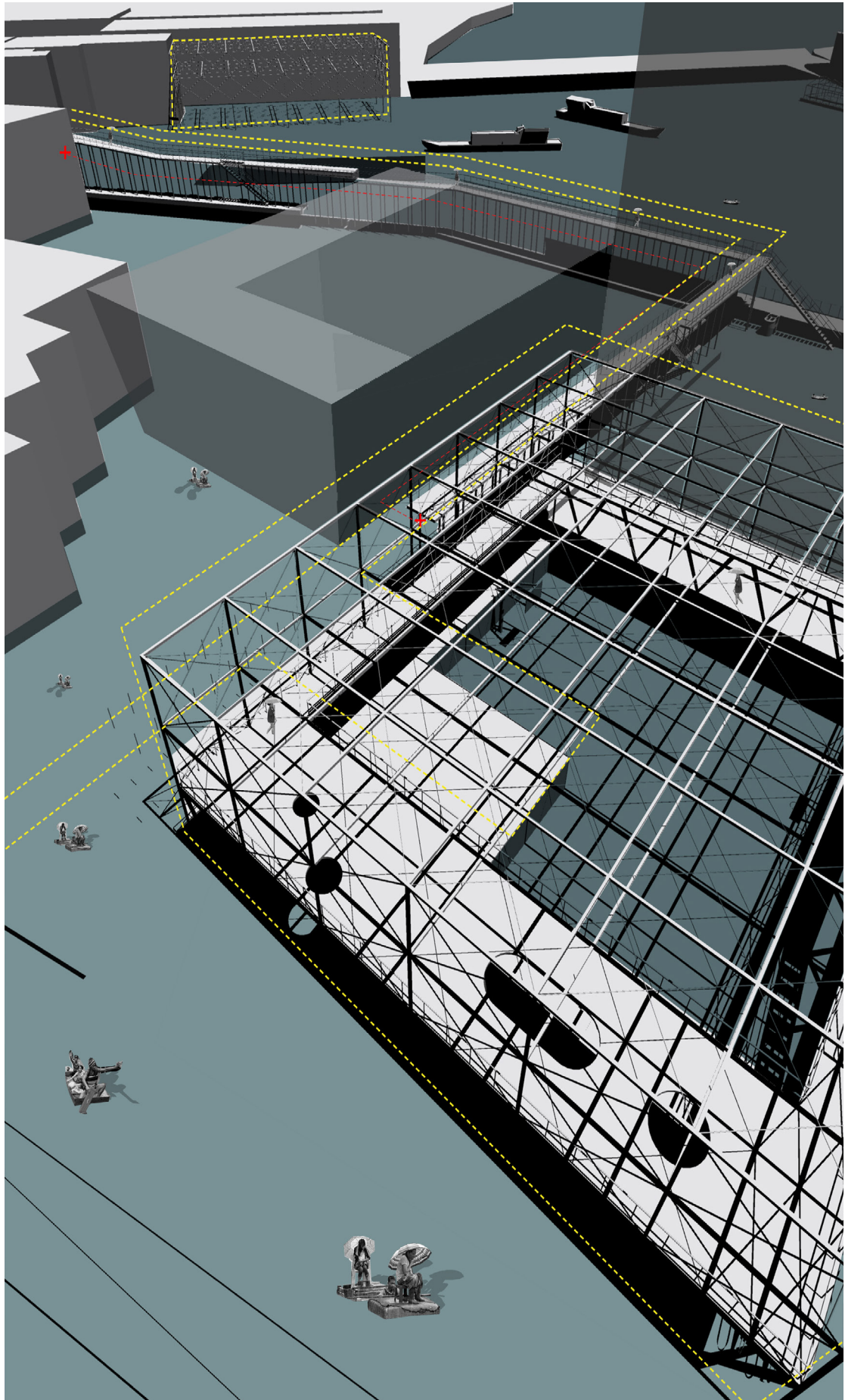


Illustration 6-9 Site A Perspective 2 of historic neighbourhood showing covered water square and connective routes



Figure 6-6 Elevation of Santa Ana - post-industrial site B

## 6.2 Santa Ana - Post-industrial Site as Testing Ground for 'Building' Interventions

The second case study, Santa Ana (Site B), lies in the middle catchment of the river and is largely defined by its post-industrial character. The area of investigation was defined by the edge to the Pasig to the north and a neighbouring historic urban grid to the south, which hosts a mixture of functions including markets, a local church and two schools. The site is within a 5km range of Makati City, the financial capital of the Philippines, and has the potential to be transformed into economically higher value developments that could 'distribute economic opportunities to the local community, and add to the city's inventory' of [public] spaces (Tomeldan 2016). Currently, this translates as gentrification, with larger stretches of former industrial areas along the river indiscriminately replaced by high-rise residential towers for the country's growing middle class (Michel 2010, p.239).

The design investigation questions whether the area could absorb the impact of density and traffic the building of high-rise developments would bring. Instead, it proposes an 'adaptive reuse' strategy for the post-industrial area as a counter proposal to existing development trends. Referring to Manila's City ordinance that has reclassified Santa Ana from its previous 'industrial' classification to 'medium intensity commercial/mixed-use zone' (Manila Comprehensive Land Use Plan 2006) the project proposes a mix of small to medium scale building typologies that can respond to the site's natural flood patterns and the existing industrial heritage. The design study explored a range of building typologies, starting from the water edge and moving across Santa Ana's post-industrial area. The buildings were developed iteratively in response to potential flood heights and tested mainly through architectural sections. The study explored flexible and replicable design solutions, and two themes emerged:

First, buildings as urban acupuncture. This concept formed a targeted way of planning, which pinpointed the vulnerable areas of the neighbourhood and revitalised them through design interventions (Lerner 2016). Key locations were identified as starting points for redevelopment that would connect from one location to another over time to another set of points in the neighbourhood (Navarro Sertich 2011). By allocating specific programmes to the buildings, they were transformed into centres for health, education, recreation and culture. They formed smaller-scale additions in the neighbourhood that in conjunction with the

surface interventions could address environmental and programmatic challenges of the community at the same time.

Second, buildings and verticality. By setting the anticipated flood height as a datum for design, the building interventions needed either to be able to adapt to incoming overflows or be raised well above the flood line. This created a system of stratification. Flexible programmes and structures were proposed below the flood line and more permanent functions for the buildings raised above ground. The ground plane could, for example, host seasonal street markets, whereas the raised building could be used for other types of community-related activities. The design study therefore looked at the section in a new light, creating a dynamic mix of programmes and uses across the whole site. The site's ferryboat station and its connection to significant heritage sites were used as starting points for the design exploration. Floating buildings, for instance, could be docked along the river edge, and the zone at immediate flood risk would be reserved for temporary or amphibious occupation. The existing warehouses further away from the river would be redesigned and flood-proofed. With only little room to retreat, any new development could be raised above the existing urban grain.

The choice of building intervention was informed by research into the historic occupation of the river edge, but also earlier research into global examples of floating, amphibious and raised building typologies. Traditional floating markets were reinterpreted as future floating gardens, living units and community facilities. By extending the framework of potential interventions onto the river edge and onto the water, a continuation of the city was suggested through a mobile floating landscape that could appear and disappear seasonally (Olthuis 2014).

Amphibious buildings were proposed on the ground that is seasonally affected by flooding. These are able to adapt to variable flood levels and keep an elevation above water level at all times. The development of such typologies is well established in the Netherlands and has only in recent years gained interest in places such as Bangladesh and New Orleans (English 2006, Prosun 2011), and could be considered as a suitable building typology that could be deployed along Manila's flood banks. Studies show that not only do such amphibious designs carry economic advantages (not requiring a costly foundation), but they also provide social and urban benefits: retaining an active ground plane and avoiding unoccupied spaces at street level (Prosun 2011)



Raised typologies could as well include building over existing buildings. Applying and transforming existing structures would allow for the different elements on the ground plane to continue to operate. The ground level, potentially affected by flooding, would be occupied flexibly, the second level used for storage, and the raised levels for different types of more permanent community functions that could be financed through public private initiatives. Raised building typologies in a post-industrial setting create new opportunities for developing former warehouse sites. The raised development would also offer opportunities for new types of open space above ground; either raised community facilities or public rooftop gardens. The mixture of these programmes would foster the co-existence of different uses and users from various socio-economic groups in one place.

The programmes for the building interventions would be determined by the functions the neighbourhood was currently lacking, and their formal expression defined by their relative position to the water edge and the height of the anticipated flood line. From an ecological urbanism point of view, these tactical insertions have the potential to bring 'new energy to the city, and provide assistance during the process of long-term planning' (Lerner 2016) while also being able to respond to the existing workings of the neighbourhood.

The building types, whether floating, amphibious or raised above flood elevation, provided precise methods of intervention in these areas of uncertainty. Analysing their impact through drawing also demonstrated alternative occupations of flood zone. The urban ground was extended through floating elements, animated through amphibious structures or opened up through the use of the raised typology. As 'plug-in' structures each 'building' component could provide the neighbourhood with additional community and recreational programmes. Each of the buildings was also considered as prototype, with the idea that the designs could be refined over time, replicated and multiplied. As new nodes along the river they could be networked and act as systemic catalysts in the city.



#### SATELLITE VIEW & FLOOD MAP POST-INDUSTRIAL SITE (B)

Top  
Satellite view of post-industrial quarter.  
Neighbourhood of Santa Ana located to the  
south.

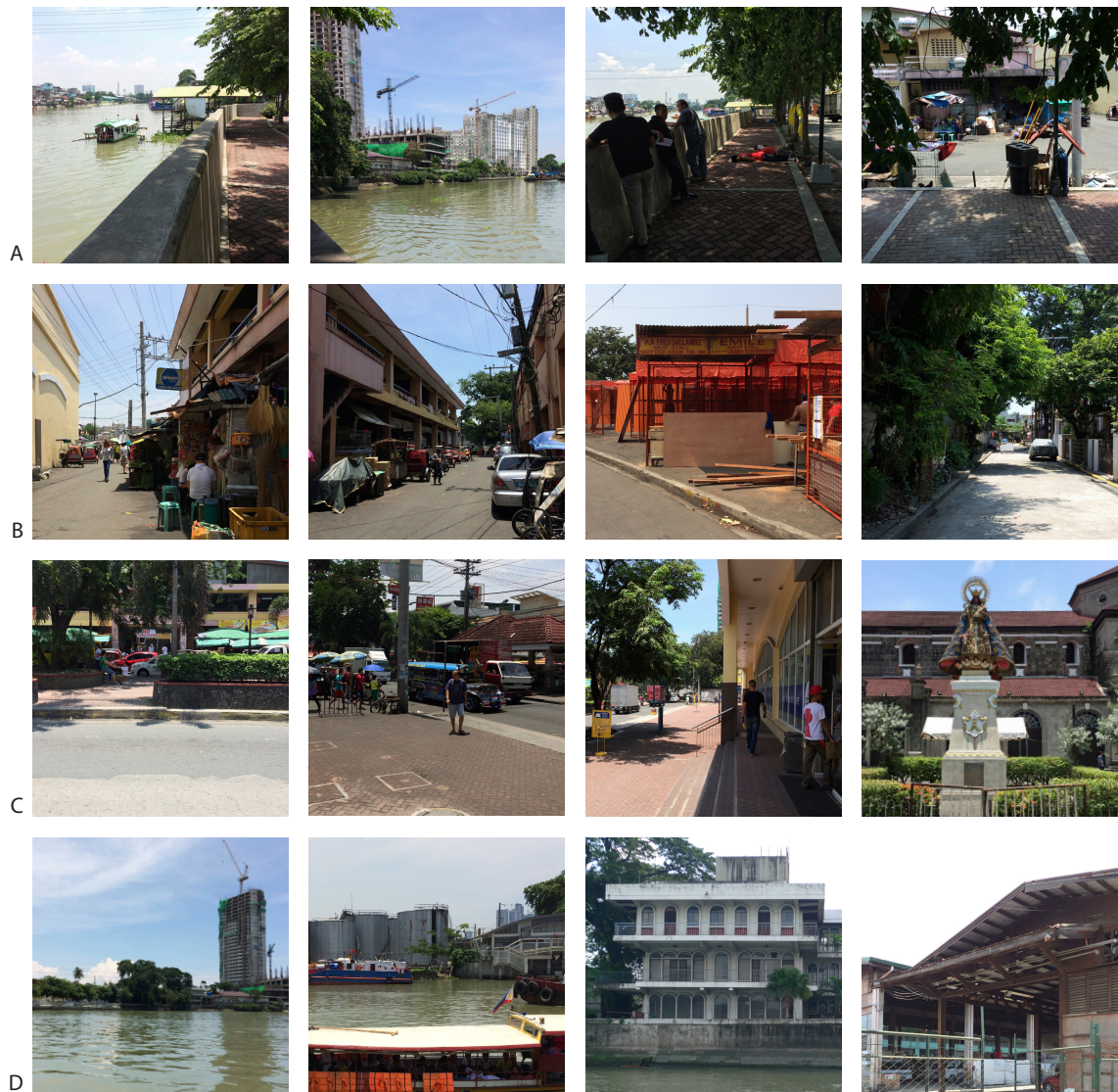
Right  
Indicative floodmap showing extent of flood-  
ing based on 25 year flood hazard maps with  
an approximate flood height of +0.5m.

Source: Project Noah (<http://noah.up.edu.ph>)



Illustration 6-10 Post-industrial site view





### URBAN CHARACTERISTICS POST-INDUSTRIAL SITE (B)

- A - Edge
- B - Paths
- C - Space typologies
- D - Details

**Edge:** River edge protected by raised dyke construction to protect former industrial area.

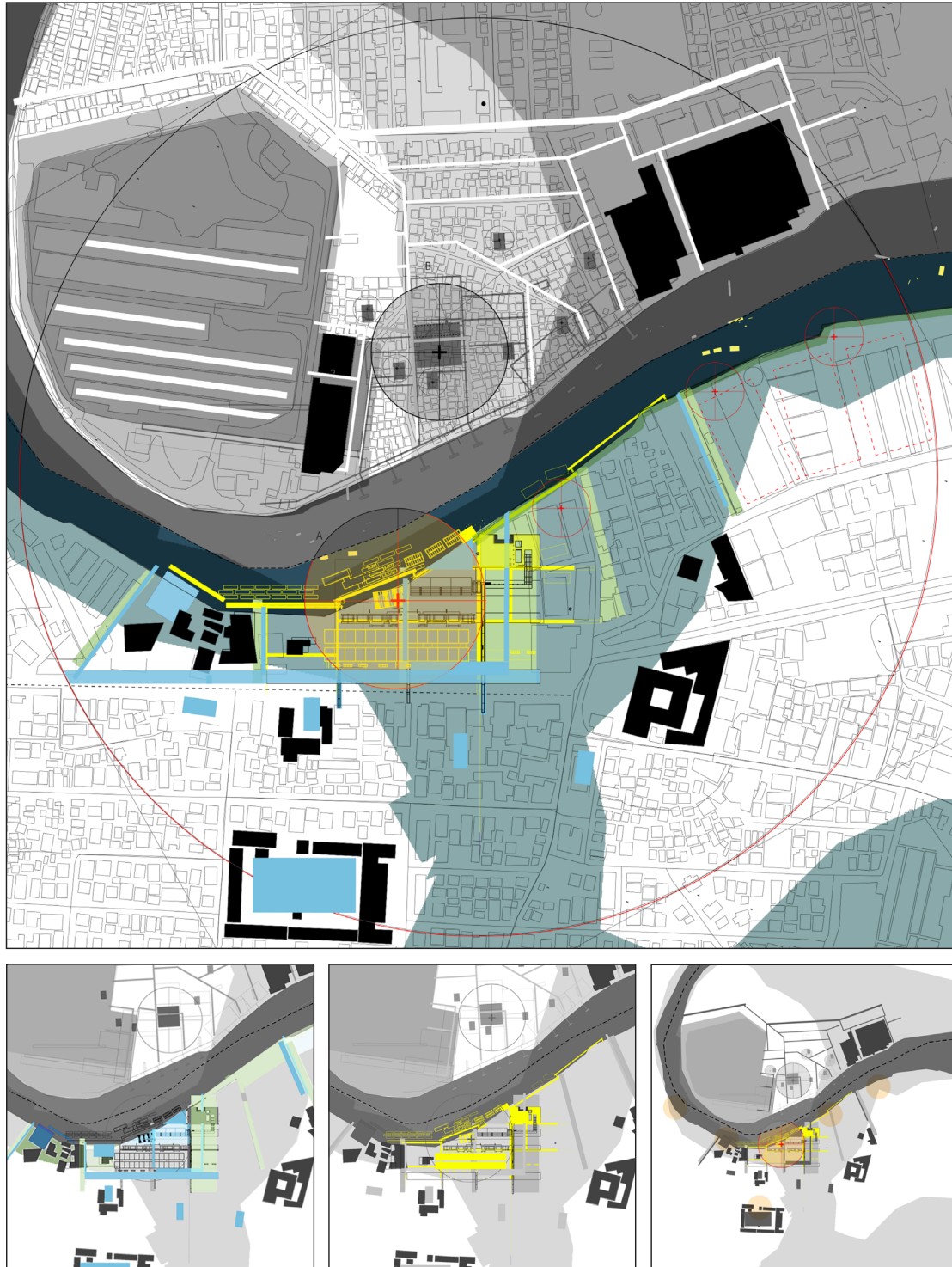
**Paths:** Streets perpendicular to the river used as informal market stalls.

**Space:** Numerous areas of post-industrial area available for large-scale redevelopment

**Details:** Area defined by unoccupied warehouses and neighbouring high-rise development

Illustration 6-11 Post-industrial site photographs





#### STRATEGIES POST-INDUSTRIAL SITE (B)

##### FLOOD MANAGEMENT

The neighbourhood is protected from fluvial flood risk through dyke construction. The permeability of Santa Ana's streets is increased through the introduction of larger scale urban parks, which act as flood retention areas during flood season.

##### URBAN FRAMEWORK

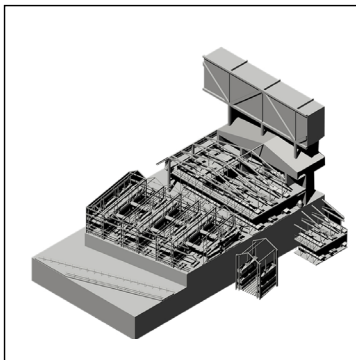
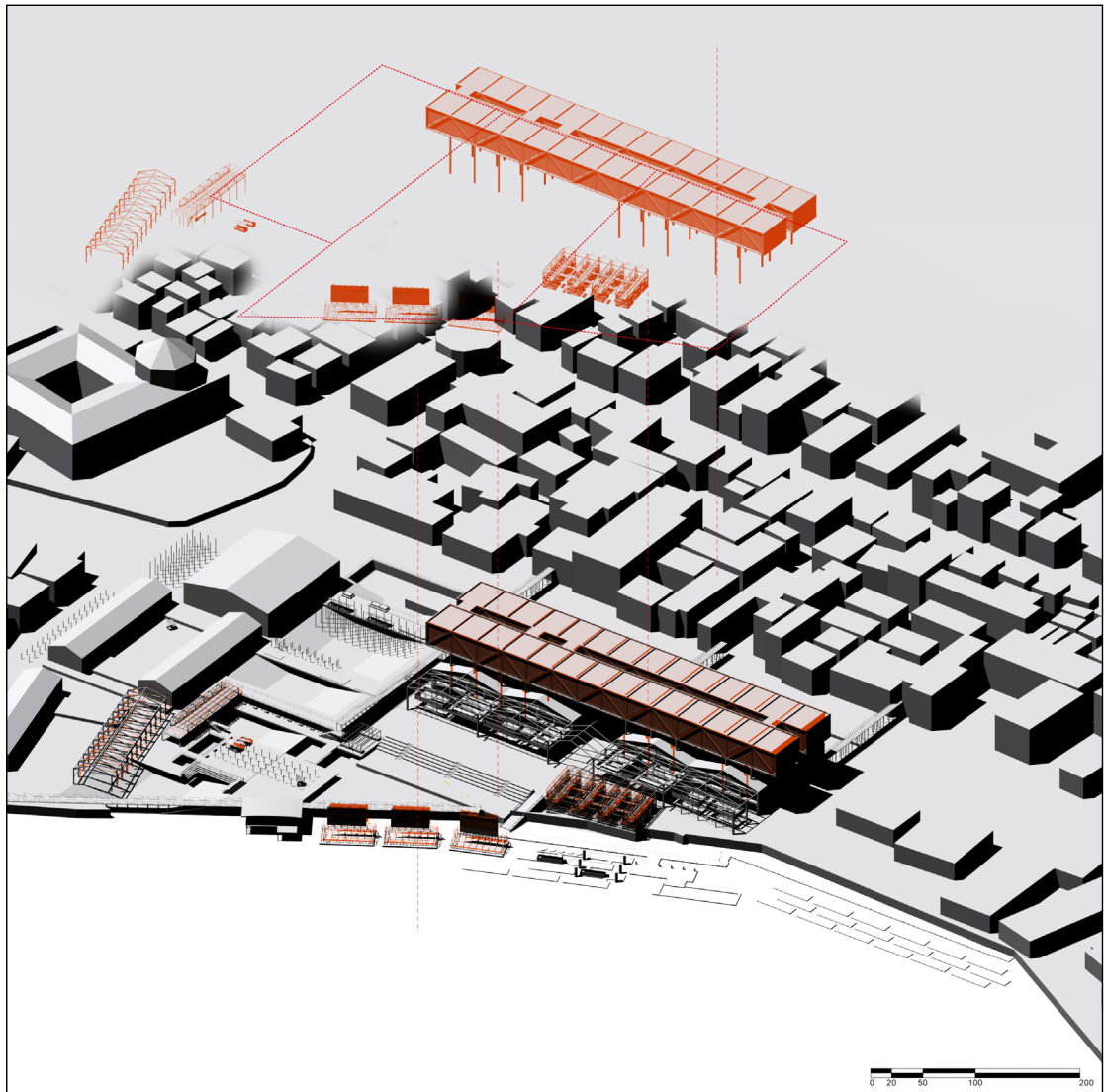
The riveredge is converted into an urban park. Floating and amphibious buildings are introduced to activate the river front. Existing warehouse buildings are converted for temporary use. Raised community buildings provide new opportunity for medium-rise densification.

##### TEMPORAL FRAMEWORK

The floating and amphibious buildings can adapt to changing water levels. The development of linear parks along the river begins to connect different warehouse sites and act as a new destination for the neighbouring areas.

Illustration 6-12 Site B Plan of post-industrial neighbourhood showing 'adaptive reuse' strategy

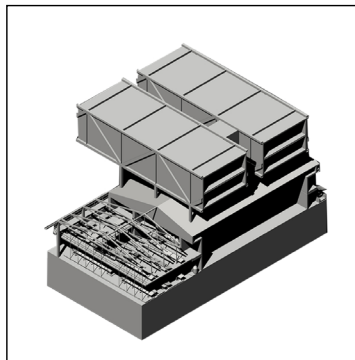




**TACTICAL INTERVENTIONS  
POST-INDUSTRIAL SITE (B)**

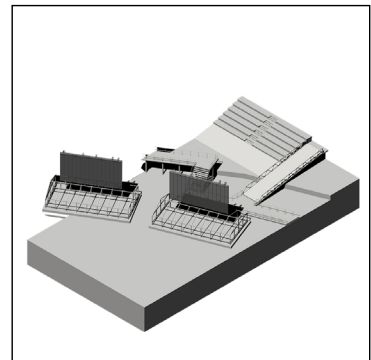
#### AMPHIBIOUS BUILDING

Amphibious buildings were proposed on the ground that is seasonally affected by flooding. These are able to adapt to variable flood levels and keep an elevation above water level at all times.



#### RAISED BUILDING

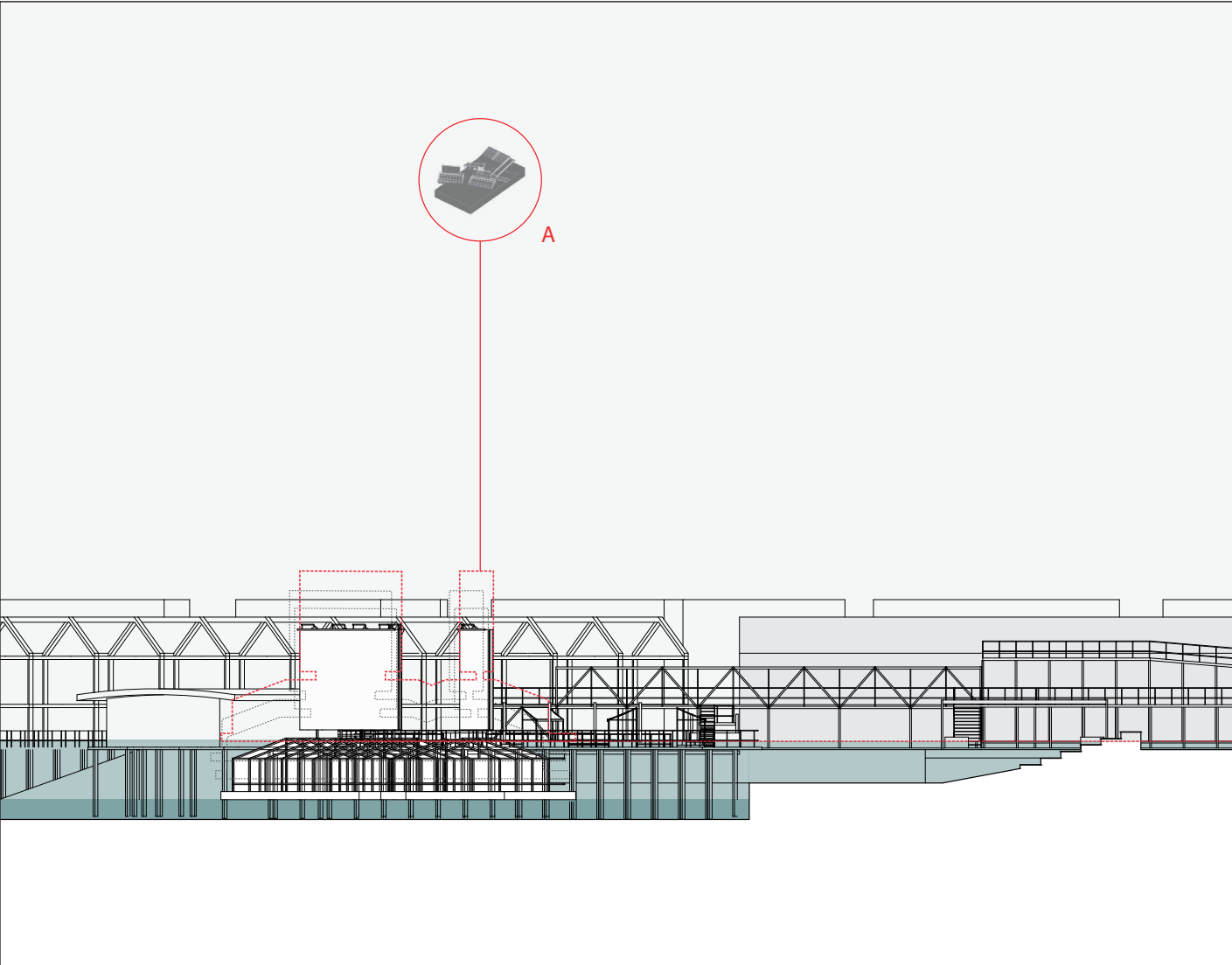
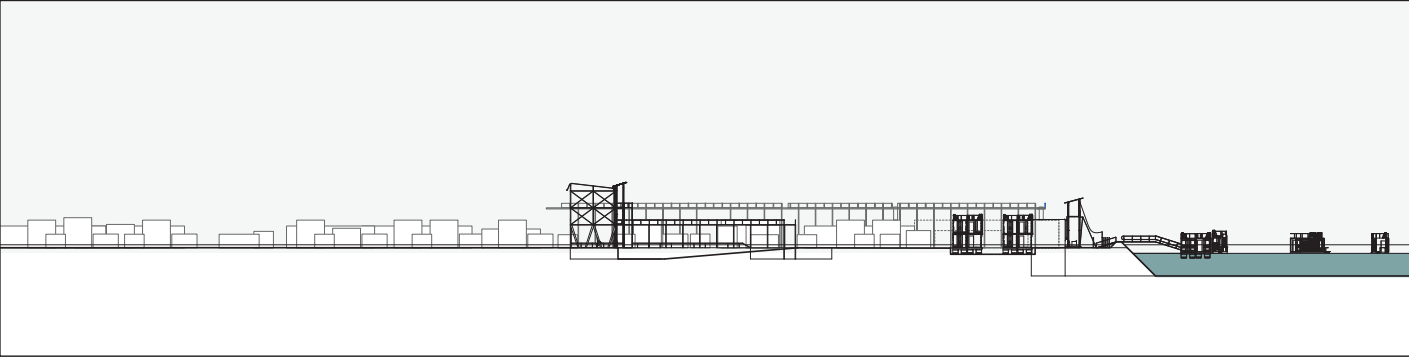
Raised typologies could include building over existing buildings. Applying and transforming existing structures would allow for the different elements on the ground plane to continue to operate.



#### FLOATING BUILDING

Traditional floating markets were reinterpreted as future floating gardens, living units and community facilities. By extending the framework of potential interventions onto the river edge and onto the water suggests a continuation of the city.

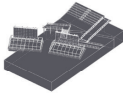
Illustration 6-13 Site B Axonometric of post-industrial neighbourhood showing network of tactical interventions



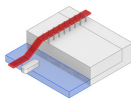
SPATIAL COMPONENTS  
SECTION THROUGH POST-INDUSTRIAL SITE (B)

A - Riveredge with floating buildings  
B - Amphibious market area  
C - Raised community buildings

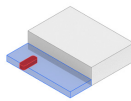
Illustration 6-14 Site B Section of post-industrial  
neighbourhood showing combination of spatial  
components



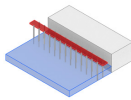
DOCKING POINT



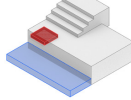
FLOATING

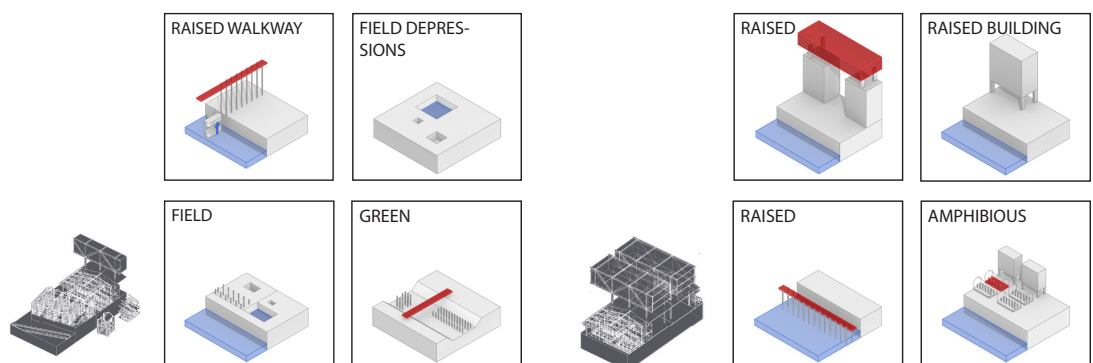
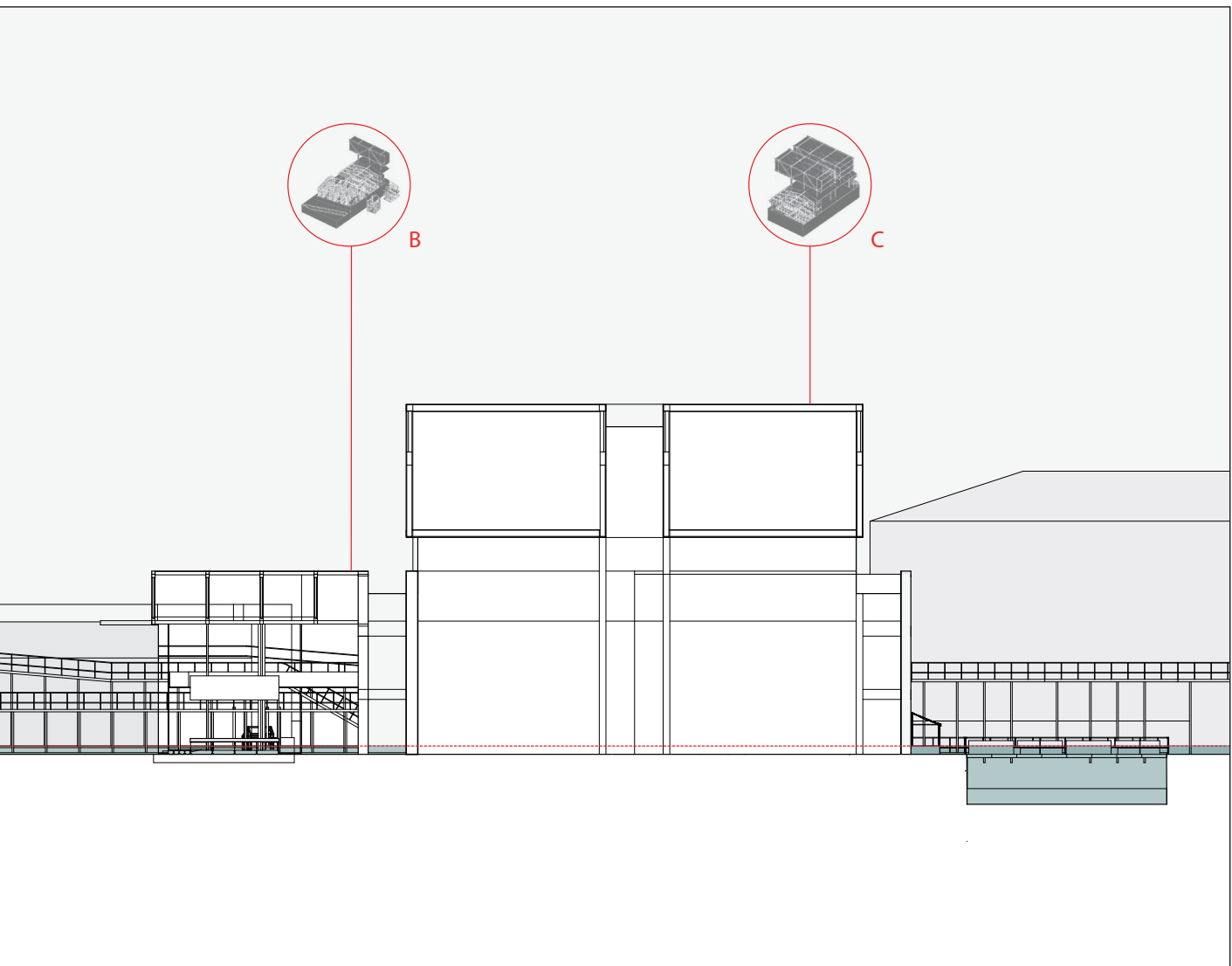
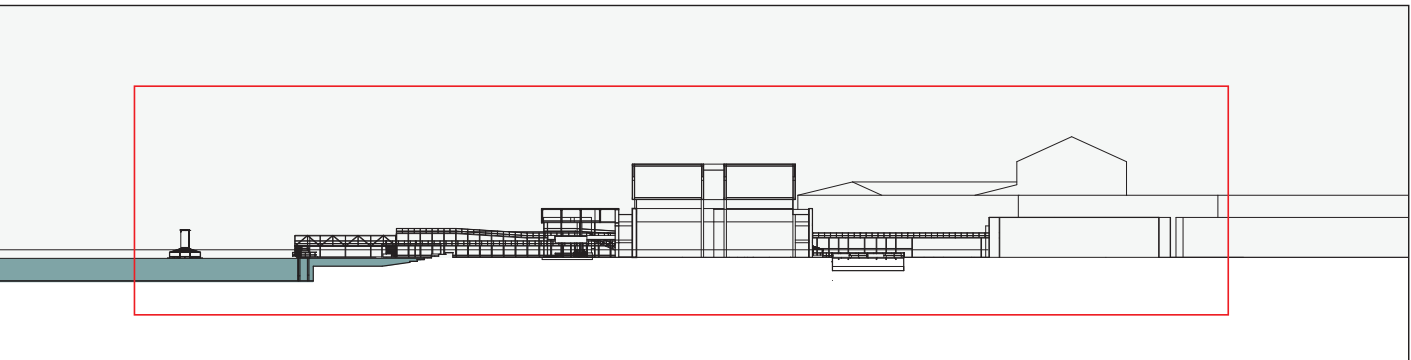


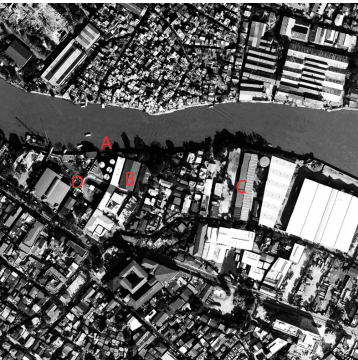
RAISED



NODE







LOCATION OF INTERVENTIONS  
POST-INDUSTRIAL SITE (B)

Typical spatial interventions

- A - River edge with floating buildings
- B - Raised community buildings
- C - Raised community buildings
- D - Area of amphibious markets

PERSPECTIVE 1  
POST-INDUSTRIAL SITE (B)

View of urban field with showing floating, amphibious and raised typologies

- A - Black indicates area of surface interventions
- B - White indicates area of building interventions
- C - Orange indicates lines of connection

Illustration 6-15 Site B Photographs of post-industrial neighbourhood showing typical locations of interventions



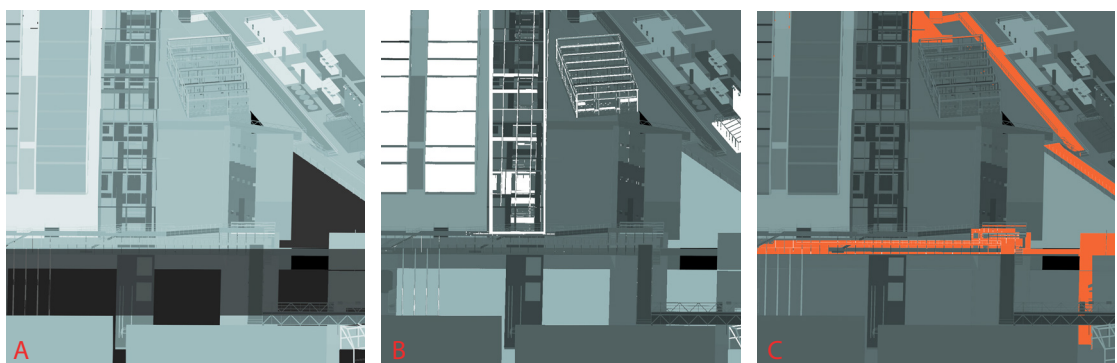
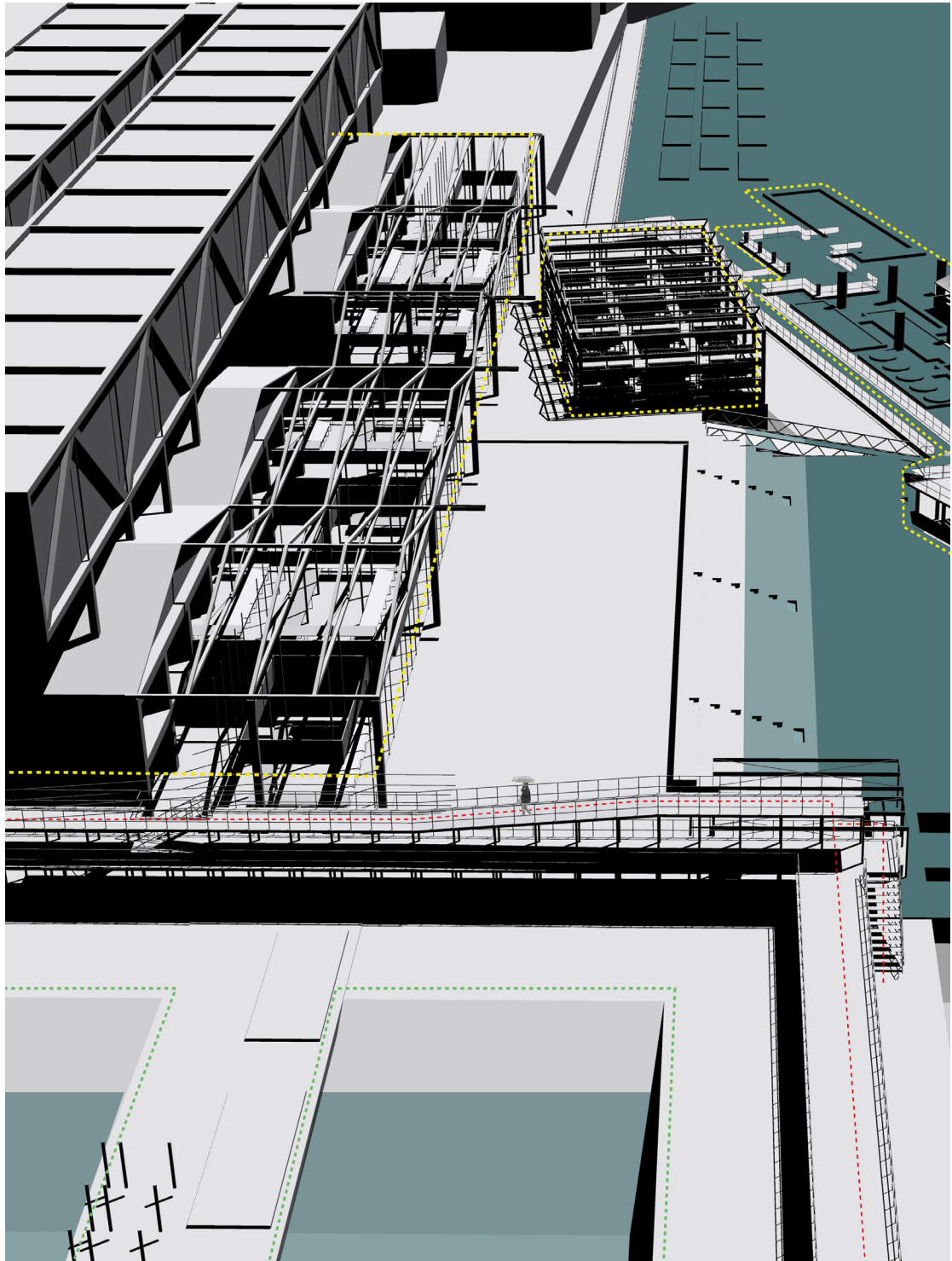
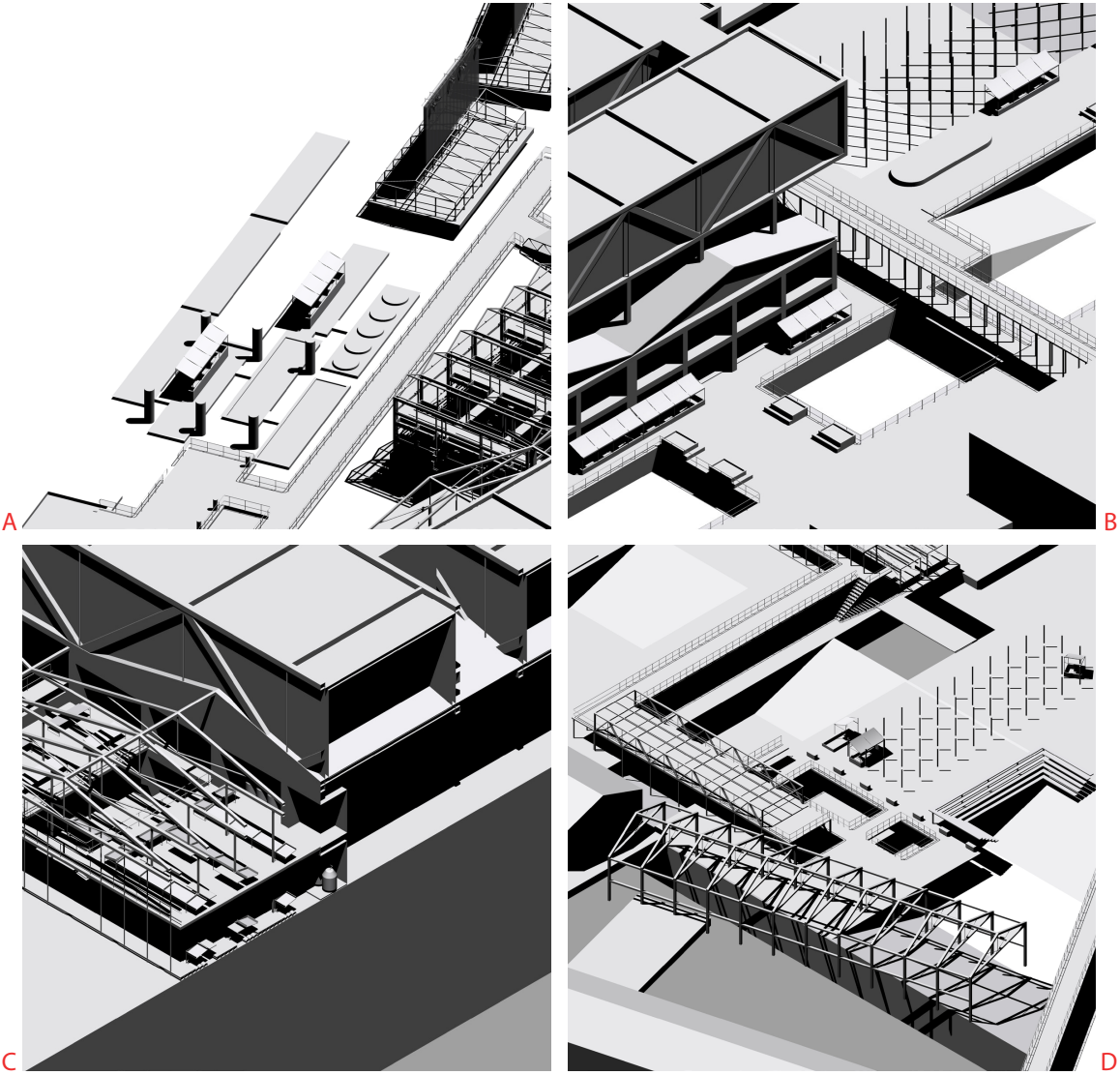


Illustration 6-16 Site B Perspective 1 of post-industrial neighbourhood showing floating/amphibious buildings



MOMENTS (TOP)  
POST-INDUSTRIAL SITE (B)

Typical spatial interventions

- A - Floating gardens
- B - Sunken SUDS areas
- C - Raised community building
- D - Urban park

PERSPECTIVE 2 (RIGHT)

Bird's eye view of urban park from riverside

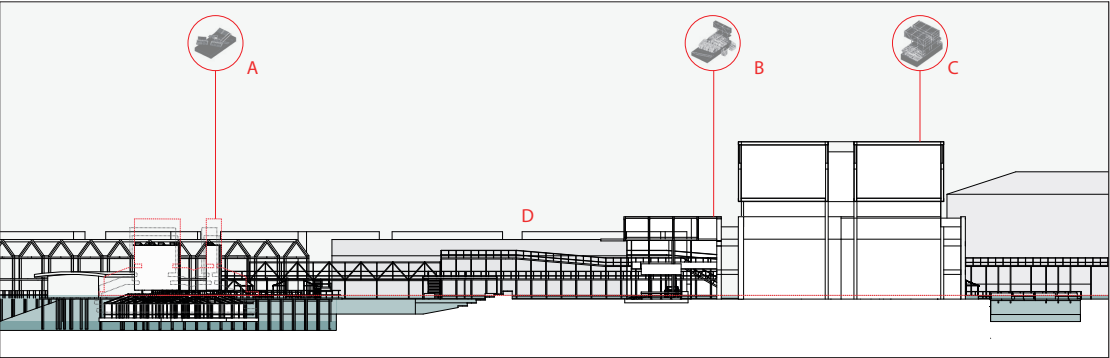


Illustration 6-17 Site B Moments of post-industrial neighbourhood of interventions in typical locations A

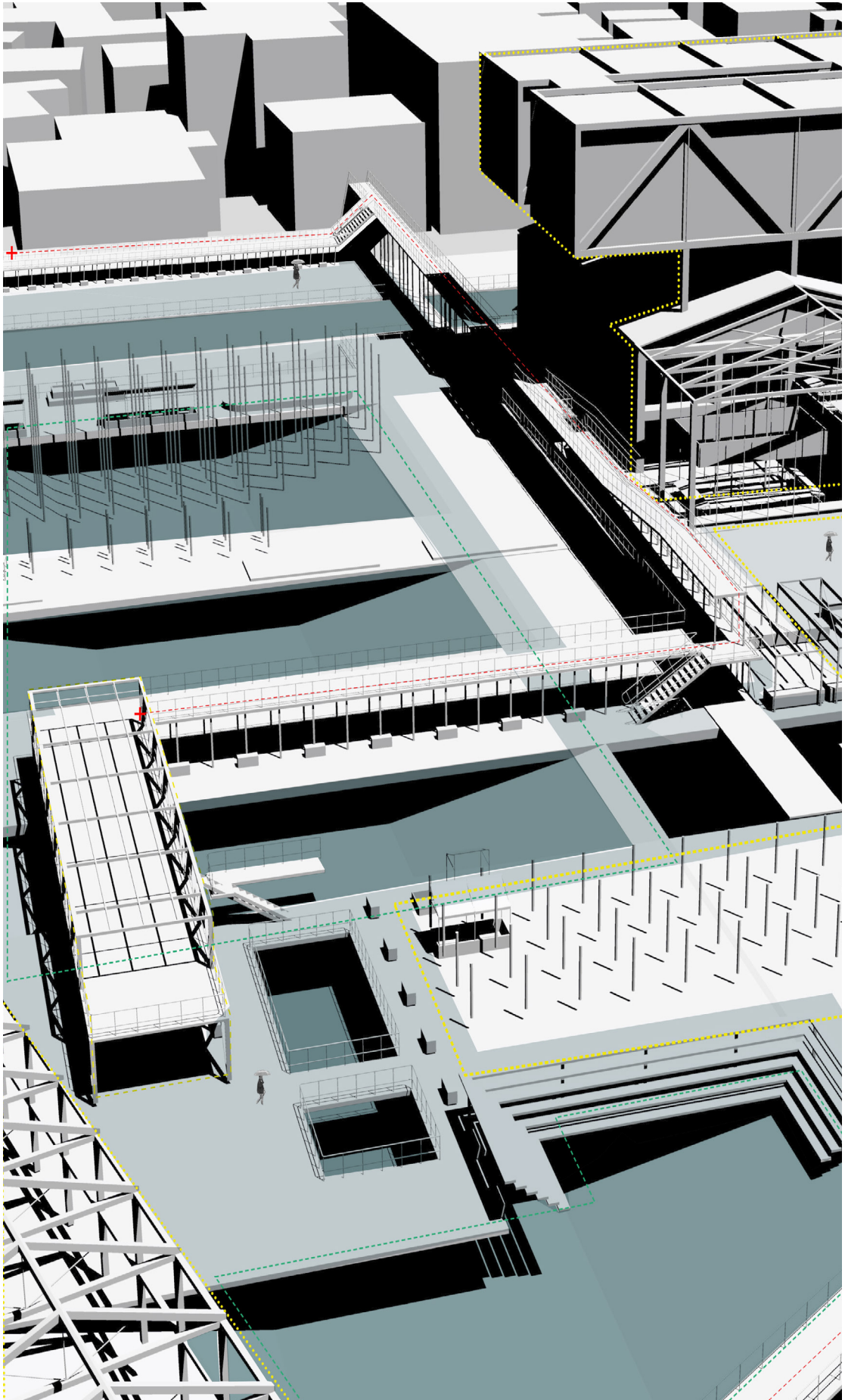


Illustration 6-18 Site B Perspective 2 of post-industrial neighbourhood showing raised building components over flooded urban pond





Figure 6-7 Elevation of Punta - informal neighbourhood C

### 6.3 Punta - Informal Site as Testing Ground for 'Connector' Interventions

The last case study, Punta (Site C), is an informal settlement that lies on the opposite side of the river from Santa Ana. Such informal developments have been identified as an integral part of urbanisation in Manila (Alcazaren et al. 2011). Beyond the inadequacies of formal planning, informality along waterways, transportation routes or next to factories creates a dominant urban pattern in Philippine cities, reflecting economic, social, and cultural problems (Loh and Pante 2015). This site represents the class that does not have access to affordable housing, livelihood and basic services. Enforced eviction programmes have led to relocation of informal communities out of town, only to find residents returning back to the city at a later stage (Romero 2013). More recent government policies on informal



settlements have shifted away from such relocation programmes and are instead focussing on on-site development (Hodal 2013). The design study complements this new direction and through upgrading strategies that aim to preserve much of the existing social networks of the neighbourhood. Prioritising the safety of the neighbourhood's inhabitants, it looks into environmentally-led forms of flood-protection and proposes a range of immediate to longer-term adaptations for Punta.

Addressing the neighbourhood's more urgent concerns, the proposal looked into the design of evacuation routes and shelters for the neighbourhood. The spatial components that were considered for this design study were a series of 'connective' design elements that would be inexpensive and easy to deploy. Due to the Punta's economic constraints, the design solutions that were explored were also proposed to be implemented incrementally. Local materials, such as bamboo, could be grown on site to create a new river edge as well as to construct the new types of infrastructure the neighbourhood required. This included the proposal for network of elevated escape routes that would be superimposed on the settlement's existing streets and houses. At ground level the walkways would provide shade to accommodate everyday functions, from commerce to social interaction. In flood situations, the walkways would provide direct access to raised multi-purpose community shelters that would provide temporary accommodation to affected residents. These shelters were seen as new centres for production (rather than as dormant structures), which outside of Manila's flood season could function as local schools or community hubs in order for them to be self-maintained.

The architectural language of stilt connections was derived from the local vernacular. Suggested as a lightweight framework, it would be able to expand incrementally and could easily be repaired, depending on the extent of flood damage (Jabeen, Allen, Johnson 2010). Such actions reflected the physical coping strategies that communities affected by flooding already put into place. Studies from flood-affected informal settlements in Dhaka for instance, observed that 'coping with climate change risks is not a new situation for the urban poor and much can be learnt from their slowly matured autonomous responses in order to build local adaptation policies and plans on the evidence-base of grassroots experience' (Jabeen, Allen & Johnson 2010, p.15). The adoption of elevated strategies could further reinforce social cohesion when applied to the creation and maintenance of common open spaces in the neighbourhood. Such urban typologies would not only create covered shaded

open space, but also encourage interactions between households, which in turn would strengthen social ties between neighbours.

In parallel to the development of walkways and shelters, the design study explored the redevelopment of the 10-metre easement zone along the riverbank, which would be developed over a longer period of time. The project proposed to move families within this risk zone into upgraded housing in neighbouring areas. Such development projects have already been piloted by non-governmental organisations (NGOs) in Manila. New government mandates have initiated slum upgrade programmes, where the move is financed by the national government, the land is provided by the local government and construction delivered by non-governmental organisations, such as Habitat for Humanity. In these pilot schemes, families that have moved would be able to pay back the government through a six per cent loan over a period of 25 years (Hodal 2013).

As part of such initiatives, the design project proposed moving the families onto floating buildings, as an interim solution before moving them to neighbouring areas. Learning from previous case studies, the examples of Mohammed Rezwan's floating schools and Waterstudio's pre-fabricated floating sea-freight containers, both developed for river conditions in Bangladesh, suggest imaginative building typologies that directly respond to fluctuating water levels. As elements created off-site and transported on site, floating platforms could further address the distinct needs of a community. Designed as interchangeable units, they could form additional interconnected public spaces, but also temporarily house different neighbourhood functions, such as community kitchens, sanitation modules or points for garbage collection. The ability to add to the existing urban fabric when needed would enable the community to fulfil their basic needs, as well as address the complexity of the neighbourhood through customisable and adaptable solutions. As Waterstudio's principal architect Olthuis argues, the floating connectors could 'strategically guide urban development, organizing slum communities and transforming these unsanctioned settlements into an integral part of the surrounding city' (Olthuis 2013, p.5).

By clearing the 10-metre easement zone, the river edge could be reconfigured. The proposal was to convert this stretch into a no-build zone, with plantation such as the growing of bamboo acting as a green buffer against potential river floods. A combination of berms and planting would dissipate the impact from fluvial flooding, with the new linear park creating

more room for the river. Over time, the river banks would be turned into productive growing fields for the neighbourhood or common recreational areas that the informal settlements are currently lacking. The neighbouring brownfield site west of Punta, originally intended as key city park for the Manila (Burnham Plan 1905), could be converted into a wetland with retention ponds to mitigate flooding.

The new networks were overlaid into the different ground conditions, creating change without causing fundamental disruptions. The design drawings suggested some of the transformational qualities that the network of surfaces, buildings and connections projected onto the context. Superimpositions, in the form of pictorial collages, created previously unseen or unimagined realities for the historic, post-industrial and informal neighbourhoods. Through constructed picture frames the urban adaptation of existing edges, open spaces and nodes in the city was imagined in wet and dry scenarios. The inserted surfaces, buildings and connections suggested how the sites' particular spatial conditions could be restructured and reprogrammed to create flood-adaptive urban ground. Seen through a temporal lens, the sites could transform organically and incrementally to create a new ecological infrastructure for the neighbourhood.

Following the design study the research returned to the opening question how architectural interventions could contribute toward establishing an ecological balance in Manila. How could the proposed architectural and urban design systems structure not only the environmental, but also social effects of Manila's river communities?

The role of design, from an ecological urbanism point of view, was also to direct the discussion of design back to the essence of 'urbanism' - which is a social concern. The role of the drawings was to identify and explore the environmental and social needs of the city, in order to suggest ways on responding to these fundamental concerns through design: the drawings could act starting points to imagine how to approach, intervene and restructure Manila's river edges. As speculative interventions, they could be regarded as forms of architecture with an environmental and social purpose; and as potential forms of action, they form a critical tool to engage with Manila's riverside communities.



#### SATELLITE VIEW & FLOOD MAP INFORMAL SITE (C)

Top  
Satellite view of the informal settlement.  
Neighbourhood of Punta located to the  
north.

Right  
Indicative floodmap showing extent of flood-  
ing based on 25 year flood hazard maps with  
an approximate flood height of +0.5m.

Source: Project Noah (<http://noah.up.edu.ph>)



Illustration 6-19 Informal site overview





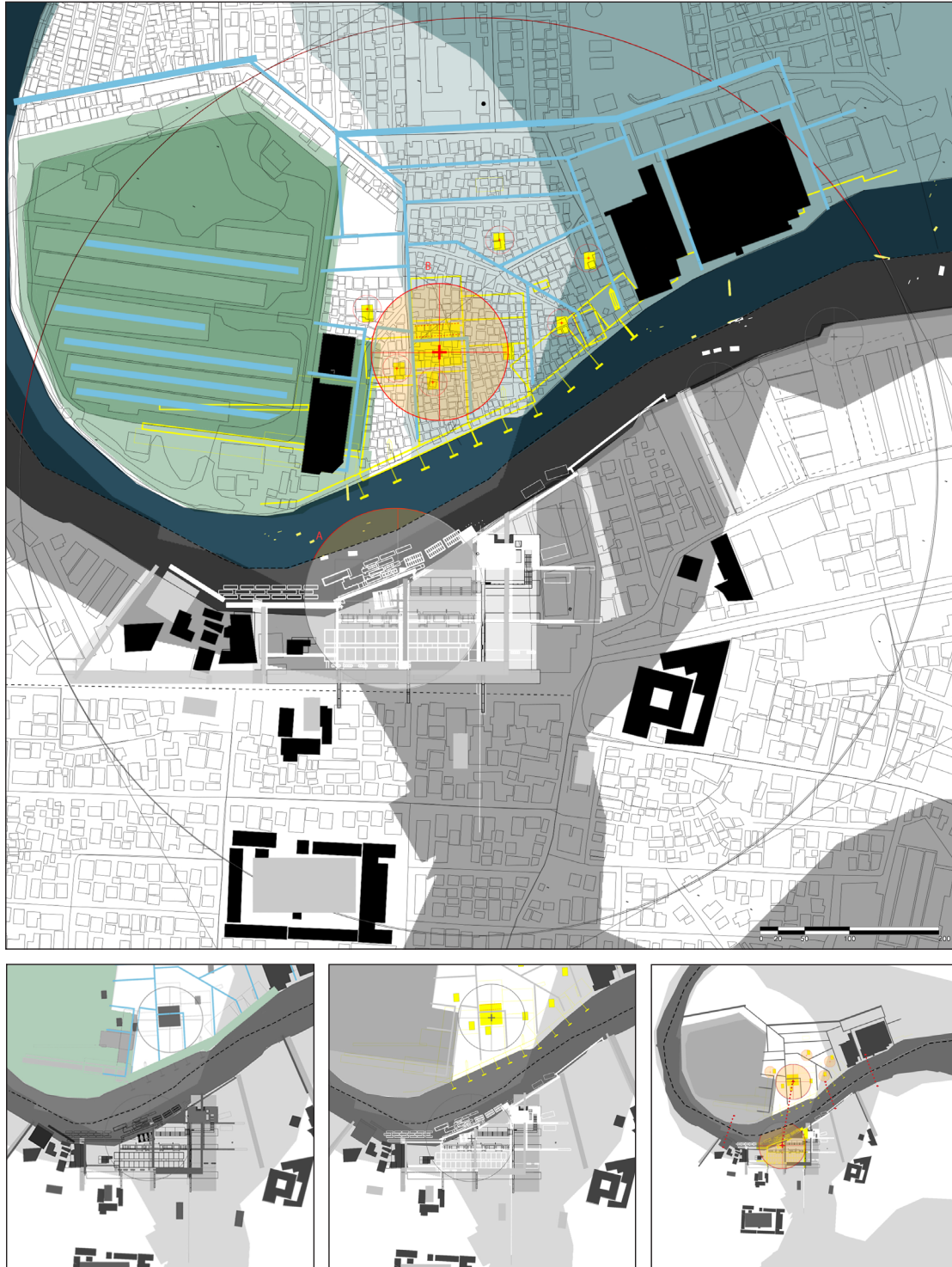
#### URBAN CHARACTERISTICS INFORMAL SITE (C)

A - Edge  
B - Paths  
C - Space typologies  
D - Details

**Edge:** Encroachment of informal building within the 10m easement zone.  
**Paths:** Streets perpendicular to the river used as informal markets and social spaces.  
**Space:** Appropriation of riveredge  
**Details:** Area defined by appropriation of leftover spaces and neighbouring post-industrial areas

Illustration 6-20 Informal site photographs





#### STRATEGIES INFORMAL SITE (C)

##### FLOOD MANAGEMENT

The neighbourhood is protected from fluvial flood risk through new bamboo plantation. Areas west to the neighbourhood can be converted into water-retention areas.

##### URBAN FRAMEWORK

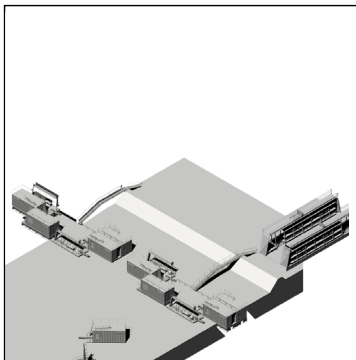
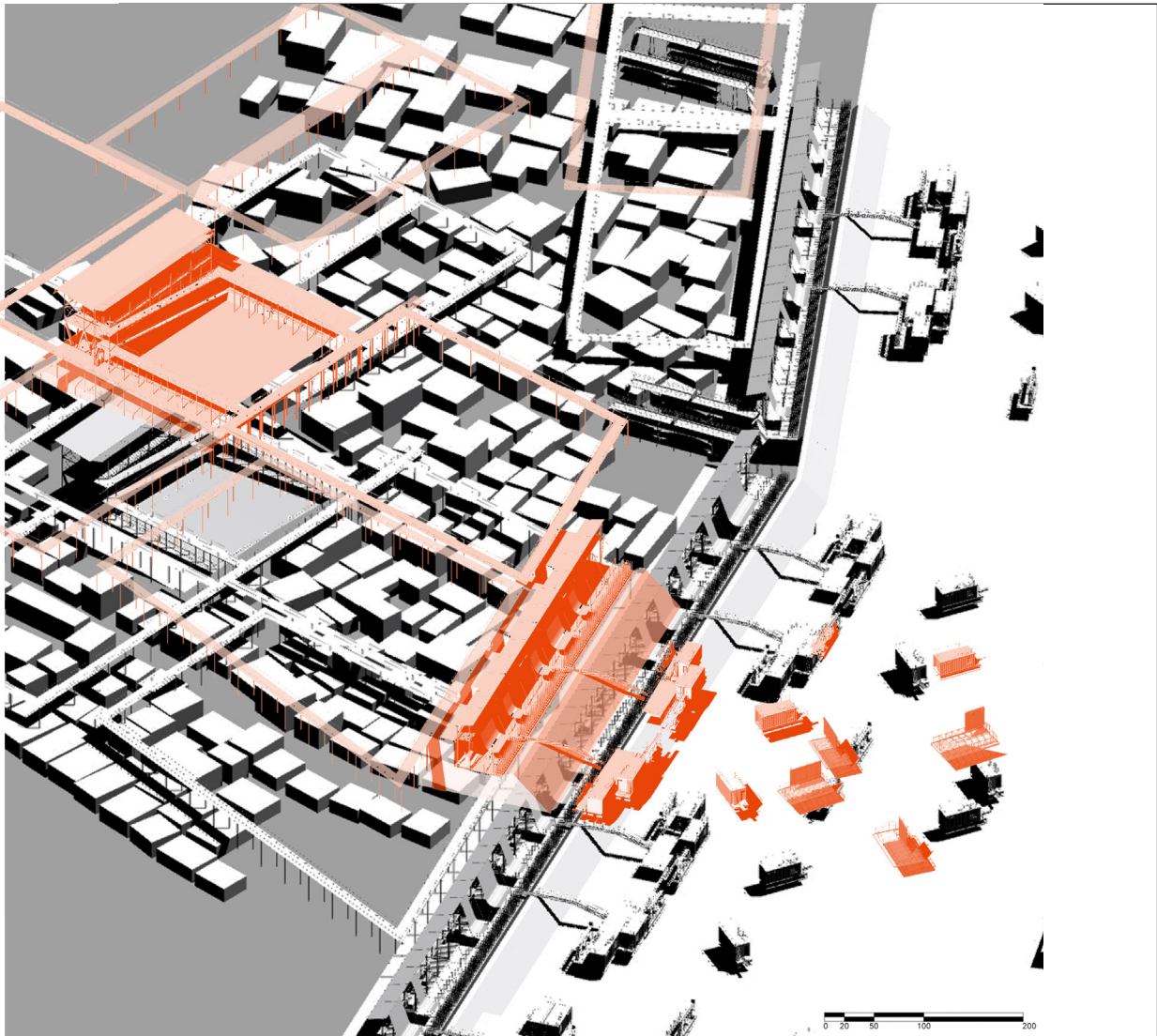
Temporary floating housing is introduced to facilitate on-site upgrading of existing neighbourhood. Raised community shelters are introduced to act as focal points for the community and evacuation shelters during flood events.

##### TEMPORAL FRAMEWORK

Raised walkways and platforms are introduced over-existing streets and houses. The network of walkways creates shade for everyday function. During flooding, these act as evacuation to the local community shelters.

Illustration 6-21 Site C Plan showing 'upgrade' strategy of informal neighbourhood

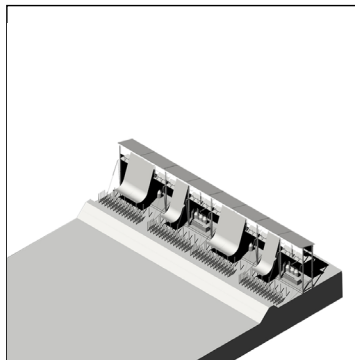




**TACTICAL INTERVENTIONS  
INFORMAL SITE (C)**

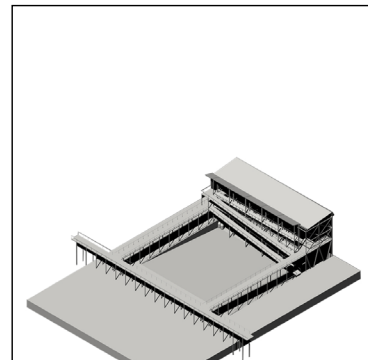
#### DOCKING CONNECTOR

The design project proposes moving the families onto floating buildings, as an interim solution before moving them to neighbouring areas. Designed as interchangeable units, they could form additional interconnected public spaces.



#### PLANTED PATH

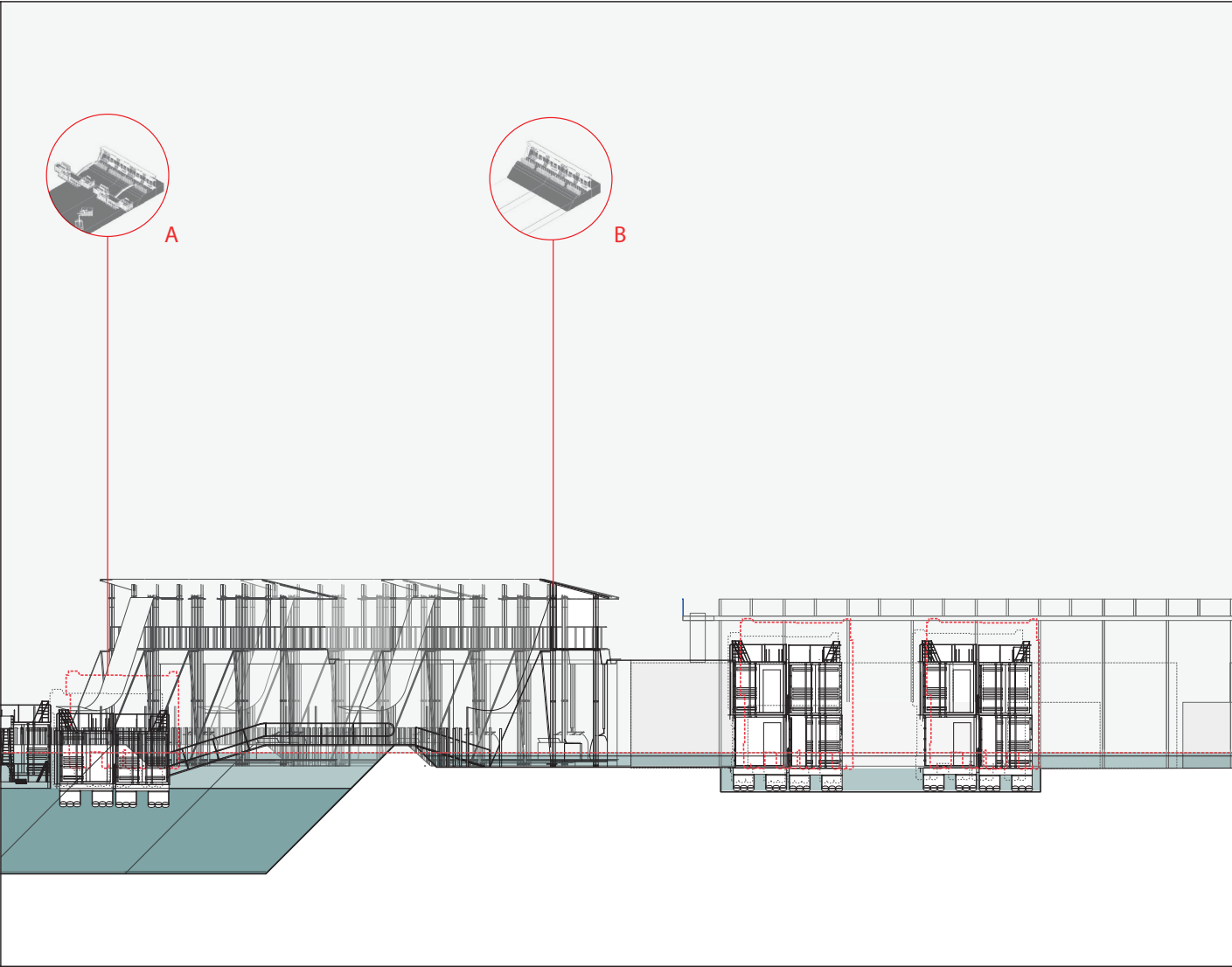
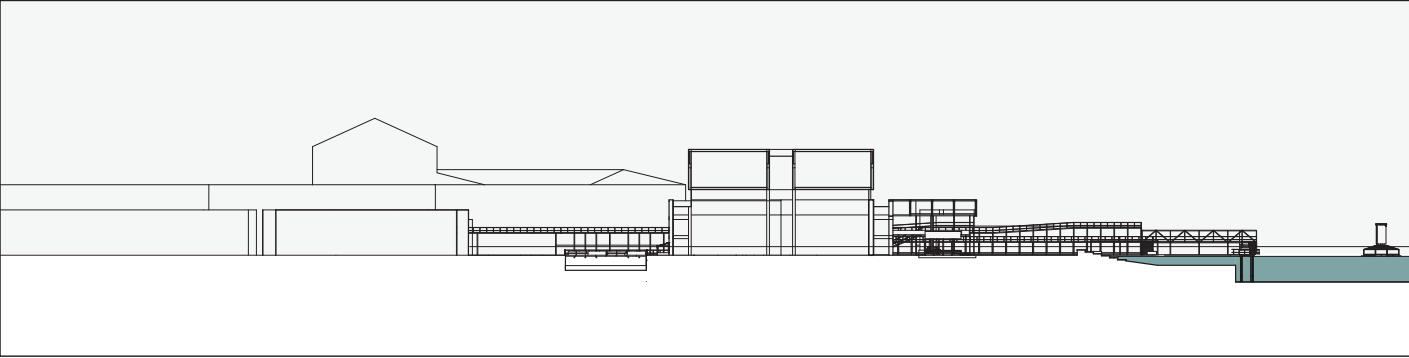
Local materials, such as bamboo, could be grown on site to create a new river edge as well as to construct the new types of infrastructure the neighbourhood required.



#### RAISED PATH

A network of elevated escape routes are superimposed on the settlement's existing streets and houses. In flood situations, the walkways provide direct access to raised multi-purpose community shelters.

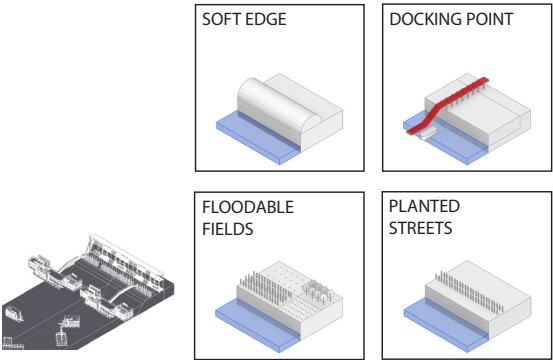
Illustration 6-22 Site C Axonometric of informal neighbourhood showing network of tactical interventions (Temporary floating housing, raised shelter, planted berm with raised walkway)



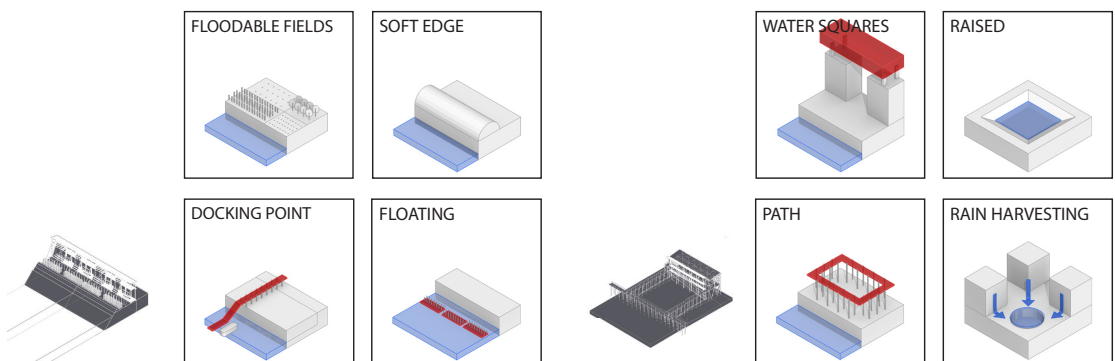
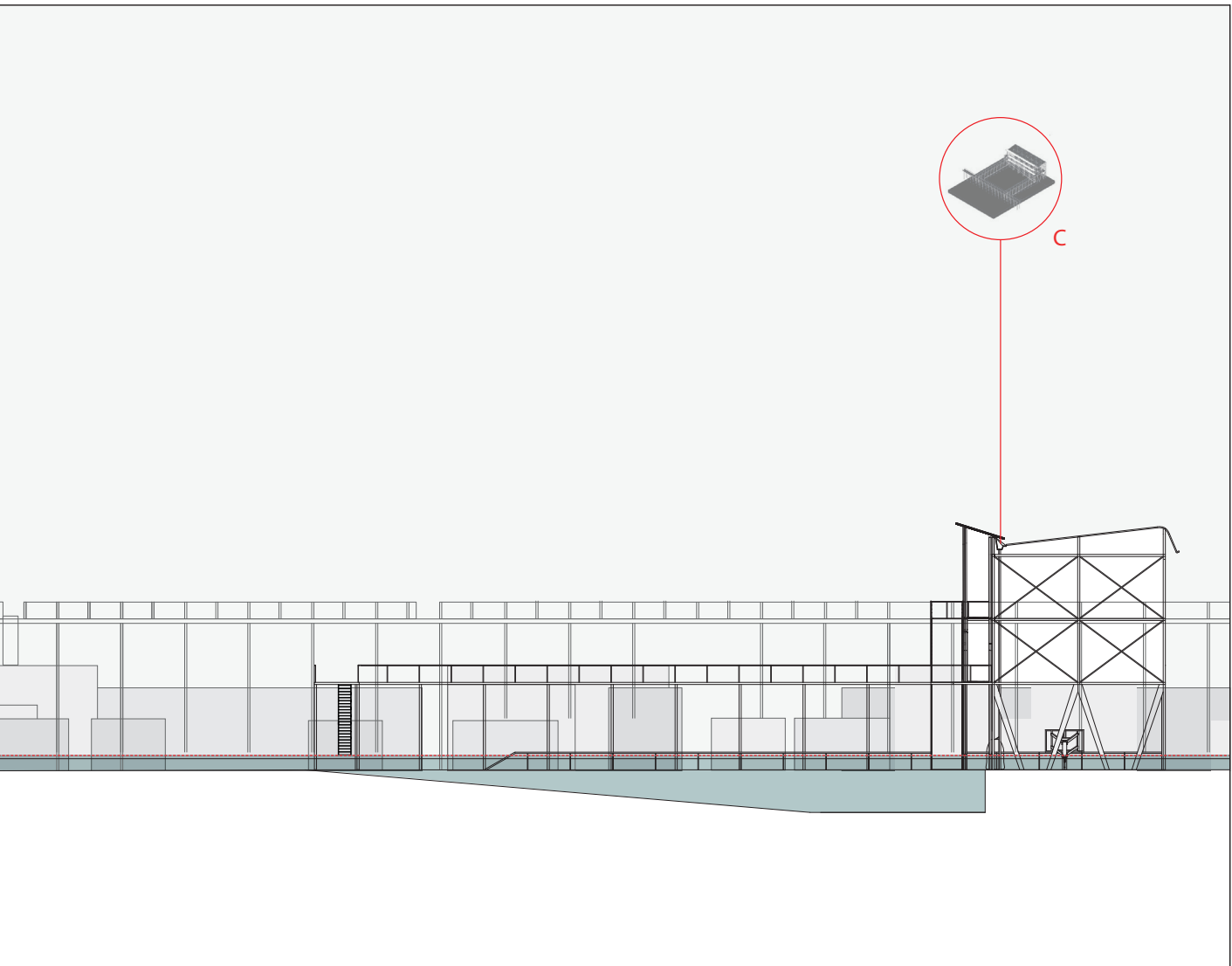
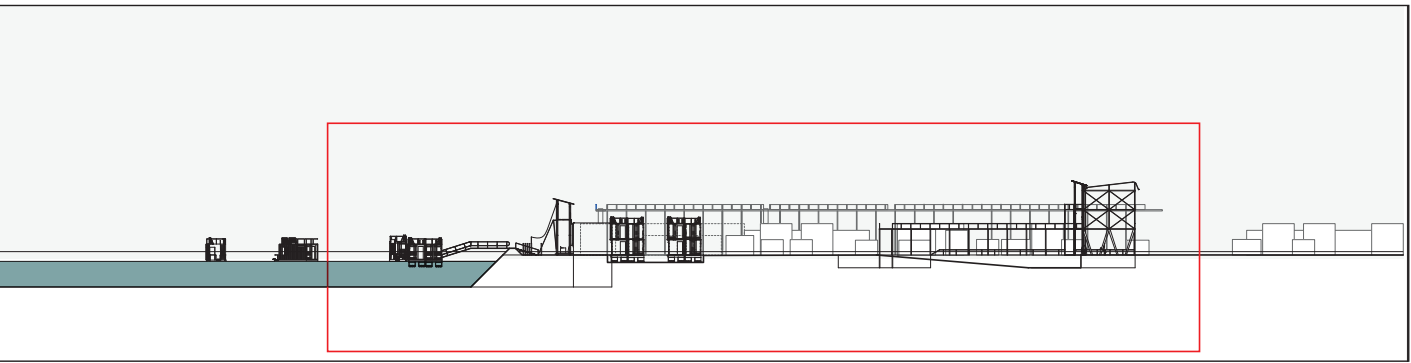
SPATIAL COMPONENTS  
SECTION THROUGH INFORMAL SITE (C)

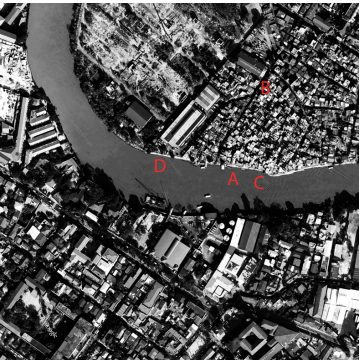
- A - Floating housing
- B - Planted riveredge
- C - Rasied community building

Illustration 6-23 Site C Section of informal neighbourhood showing combination of spatial components









LOCATION OF INTERVENTIONS  
INFORMAL SITE (C)

- Typical spatial interventions
- A - Riveredge with temporary floating housing
  - B - Raised community building
  - C - Riveredge with temporary floating housing
  - D - Area of current social spaces

PERSPECTIVE 1  
INFORMAL SITE (C)

- View of planted riveredge and floating housing with community building in the background
- A - Black indicates planted riveredge
  - B - White indicates floating housing
  - C - Orange indicates lines of connection

Illustration 6-24 Site C Photographs of informal neighbourhood showing typical locations of interventions.

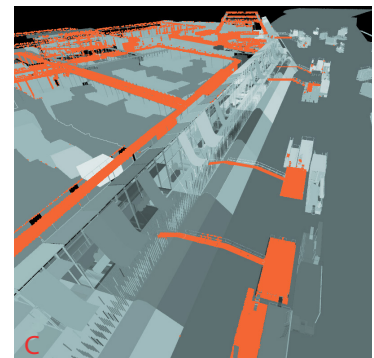
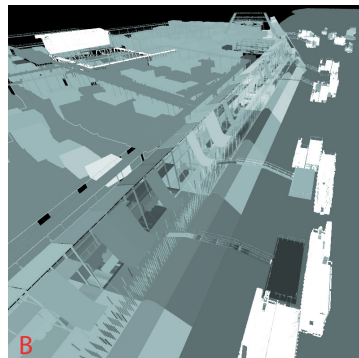
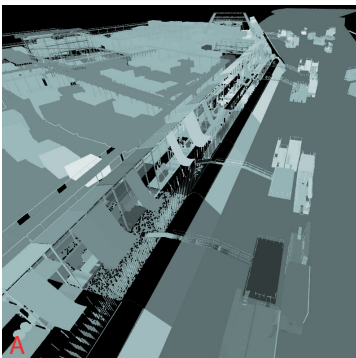
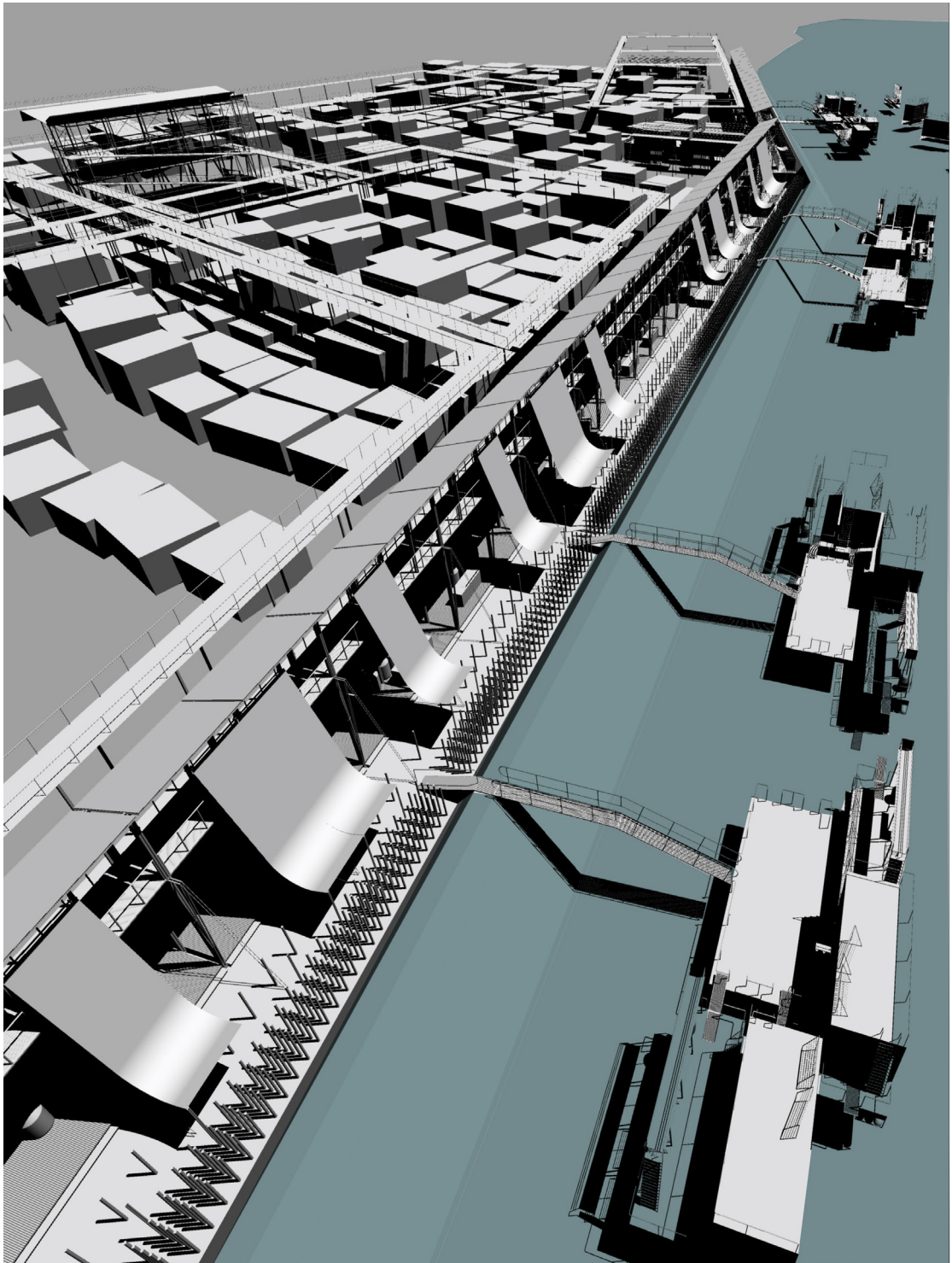
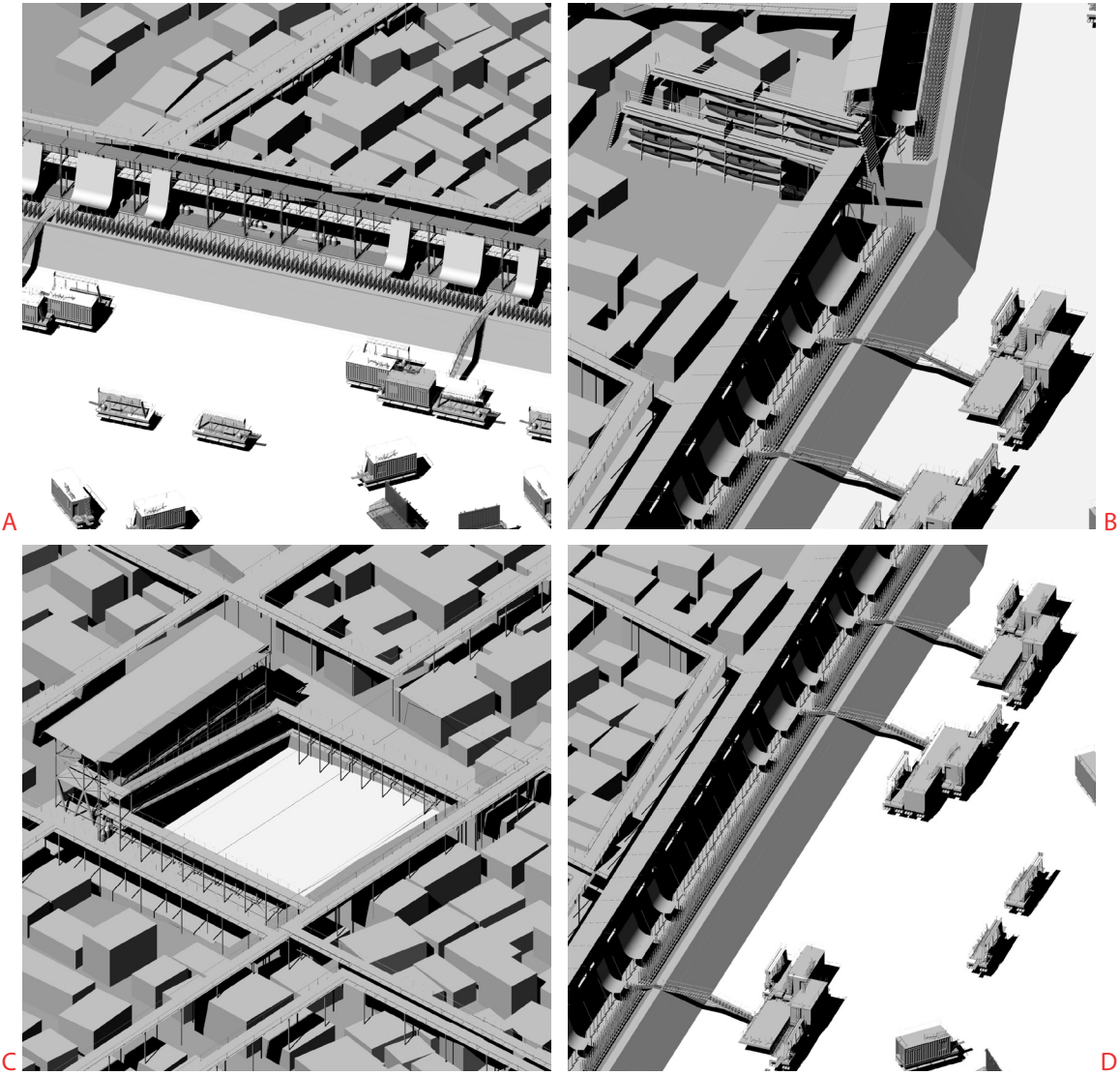


Illustration 6-25 Site C Perspective 1 informal neighbourhood showing temporary floating housing with flood-protective berm.





MOMENTS (TOP)  
INFORMAL SITE (C)

Typical spatial interventions

- A - Planted riveredge
- B - Emergency boathouses
- C - Raised community building
- D - Floating housing

PERSPECTIVE 2 (RIGHT)

Bird's eye view of raised community building



Illustration 6-26 Site C Moments of informal neighbourhood showing tactical interventions in typical locations



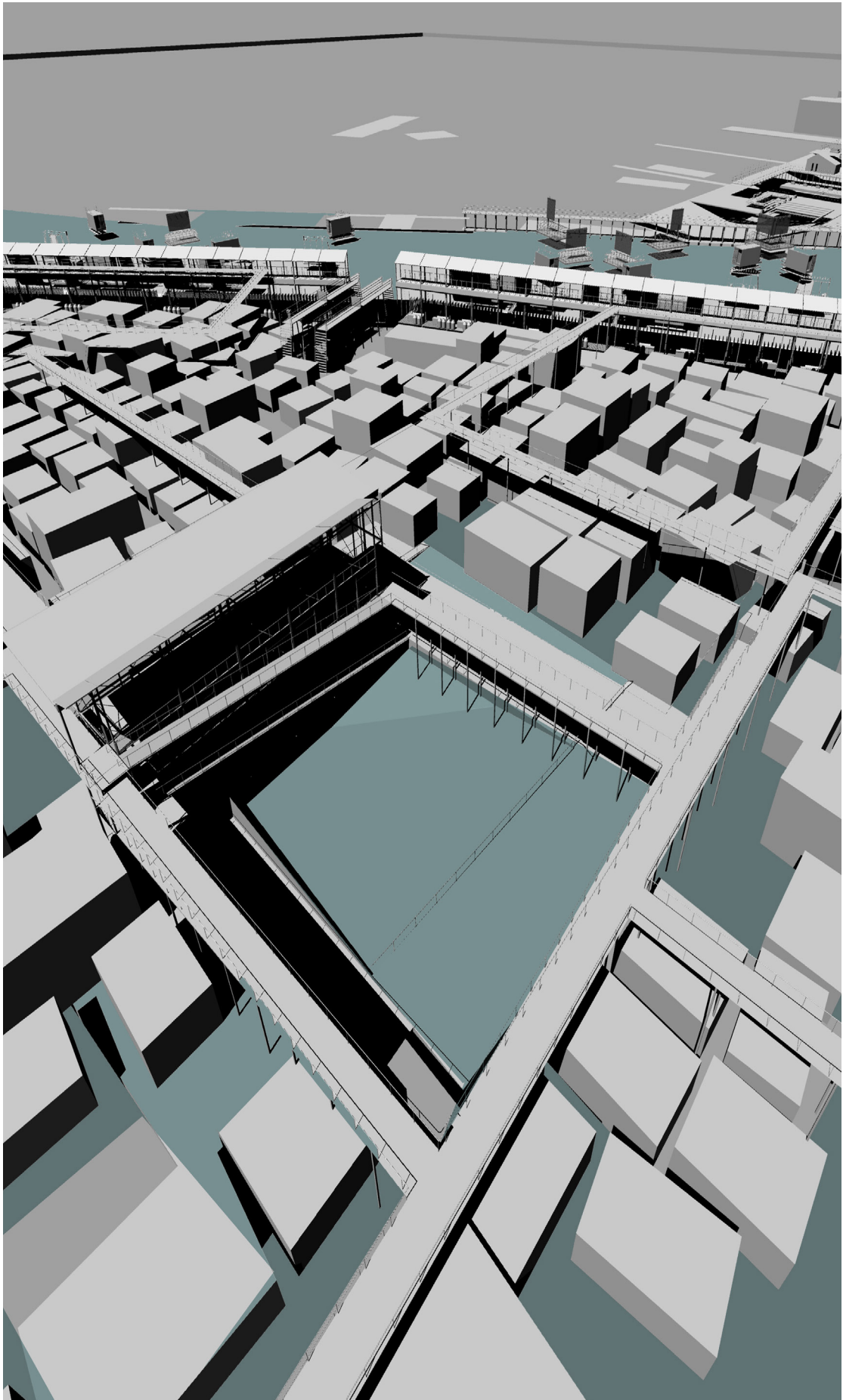
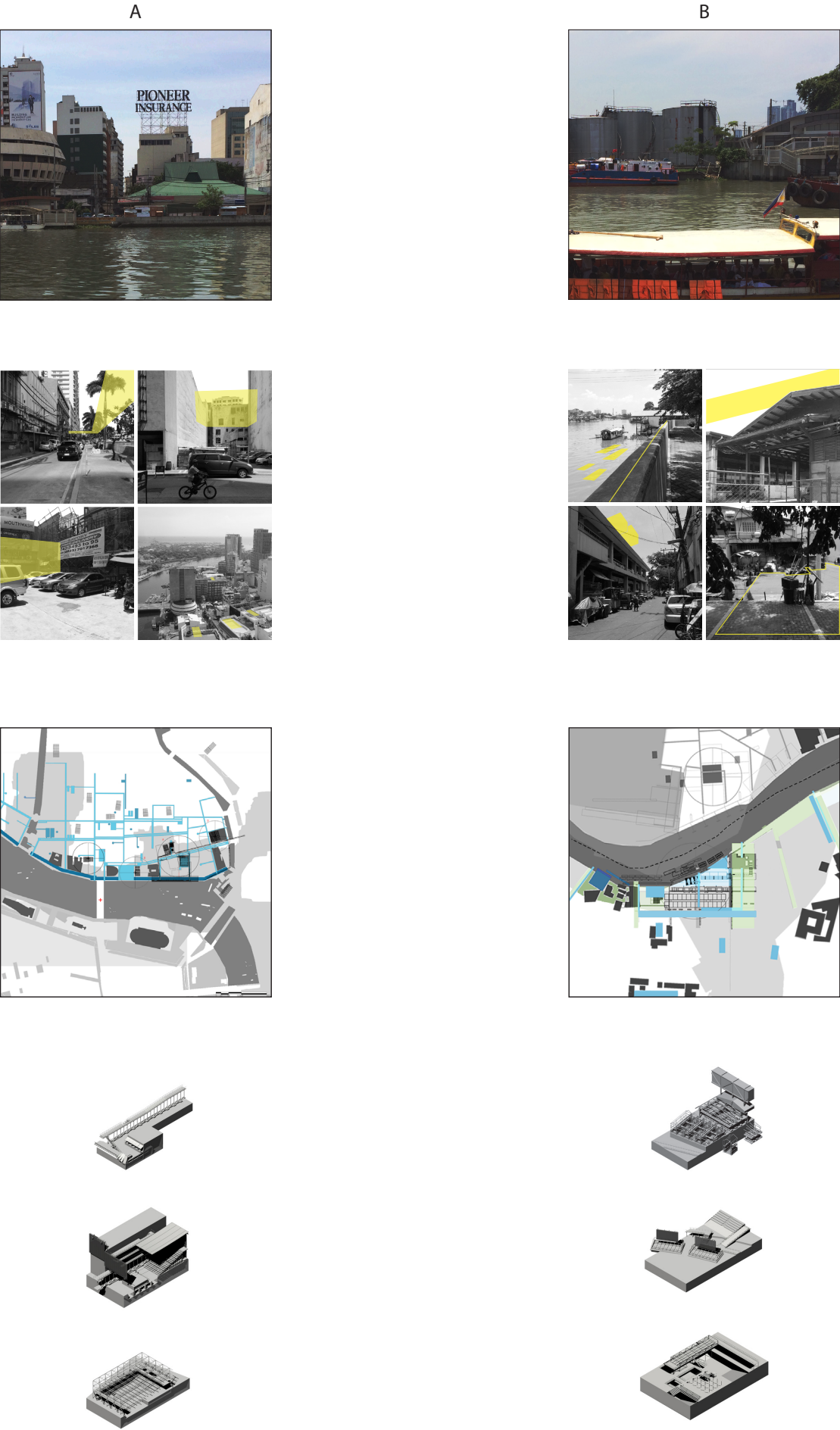


Illustration 6-27 Site C Perspective 2 of informal neighbourhood showing raised community building and raised walkways



C



## SITE COMPARISON

### SITE TYPOLOGIES

- A - Historic neighbourhood
- B - Post-industrial neighbourhood
- C - Informal neighbourhood

### SITE CHARACTERISTICS

- A - Plazas, vacant lots, underused roofs
- B - Warehouse buildings, industrial fields
- C - Lack of infrastructure, high-density



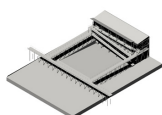
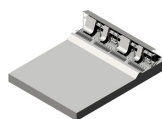
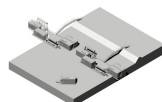
### SITE STRATEGIES

- A - Retrofitting
- B - Adaptive reuse
- C - Upgrading



### TACTICAL INTERVENTIONS

- A - Surfaces, water collection, water harvesting, channeling
- B - Buildings: floating, amphibious, raised
- C - Upgrading: docking points, plantation and community shelter





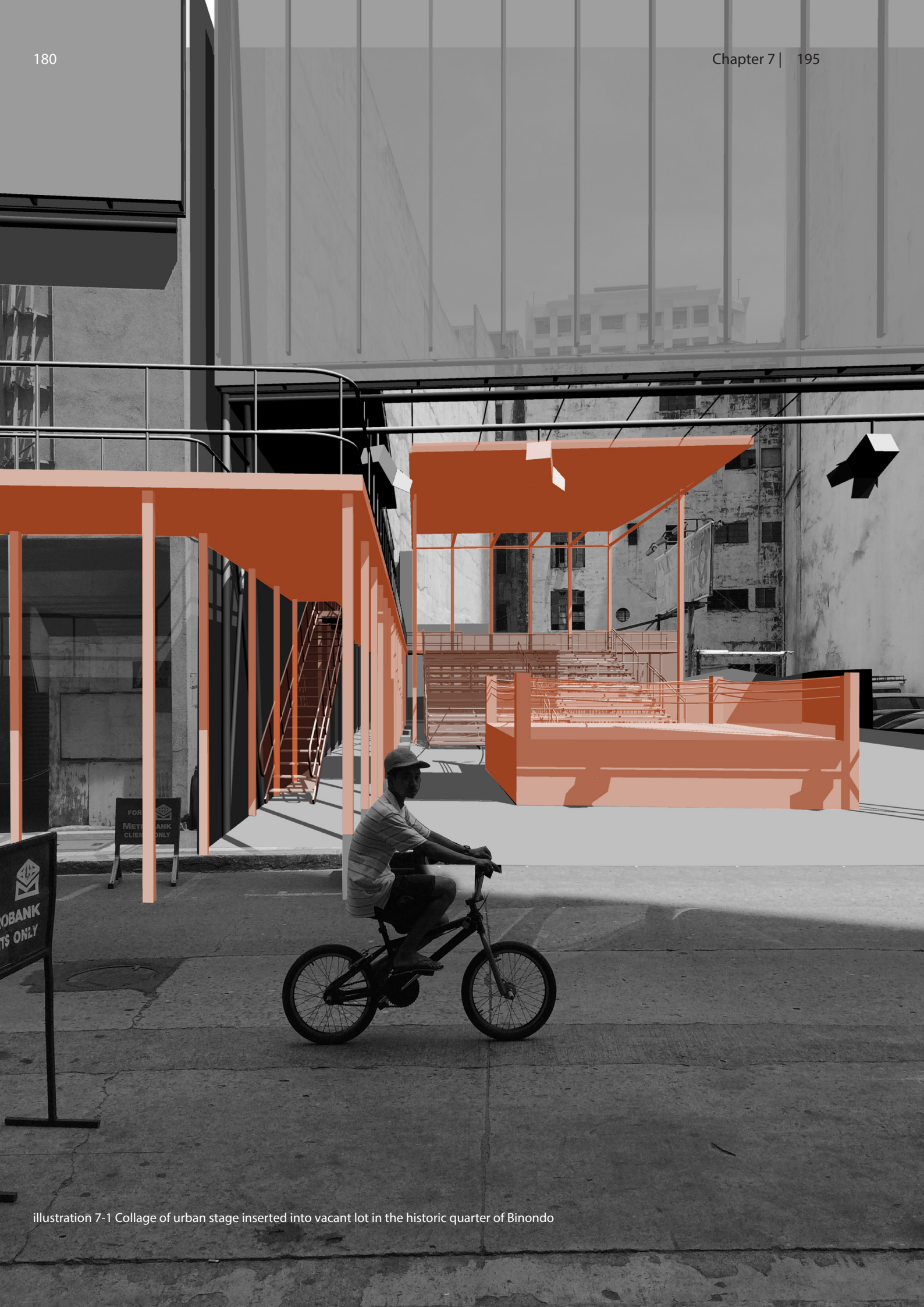


illustration 7-1 Collage of urban stage inserted into vacant lot in the historic quarter of Binondo



## Chapter 7: Performance

This chapter reflects on the value of ecologically minded design in Manila. Since the designs were generated, tested and recorded via drawings and illustrations, a means had to be developed to evaluate the proposals. The design interventions were considered in terms of their ability to retain physical connectivity during the wet season, as well as the added benefits they could create during Manila's dry period. Furthermore, design performance also considered how the interventions not only responded to varying types of urban grain, but also each neighbourhood's flood management practice, economic capacity and governance structure. But how do we know if the design is successful? The project, seen through the lens of ecological urbanism, presents design not as a set of fixed or permanent solutions, but rather as a means to adapt and continue to adapt to changing environmental and urban conditions.

The question of whether ecological urban design adds environmental, social and economic value remains an overlooked area of study in the research agenda within the built environment. While the additional benefits from better design have been discussed at a smaller architectural scale (Loe 1999), cost benefits, range of stakeholders and urban quality create an even greater complexity to consider when looking at the larger urban scale. The value of ecologically-minded design can of course bring direct benefits to stakeholders. Flood-adapting a building or a neighbourhood, for example, can be evaluated in monetary terms through their real estate value. The environmental improvements and the social benefits that are brought to the wider society, on the other hand, are not easily quantifiable (Britton 1989).

Two questions therefore needed to be asked with regard to this design research: first, how can good ecologically-driven urban design be defined, and second, how is it possible to make objective judgments of the relative merits of particular design solutions? The goal of ecological urbanism – to establish 'artificial ecosystems' that balance the interdependent environmental and urban performance in the city (Hagan 2015) – provided a useful definition for this research study. The objective suggested clear attributes against which the design interventions could be assessed.

## EVALUATION OF DESIGN

		CASE STUDY	LOCATION			
		OBJECTIVES	PERFORMANCE CRITERIA	STRENGTHS	WEAKNESSES	EVALUATION
SPATIAL	ENVIRONMENTAL	FLOOD SPEED	Capacity of design to withstand oncoming flood speed			
		FLOOD DEPTH	Design of urban connectivity during flood event and the effect on existing urban grain			
		FLOOD DURATION	Continuity of vital urban functions during prolonged flood events			
	URBAN / SOCIAL	MULTIPLICITY	Diversity of use and experience for water and urban functions			
		FLEXIBILITY	Adaptability of public & private environments to flooding			
		PERMEABILITY	Accessibility of urban elements to wide range of community			
NON-SPATIAL	CONTEXTUAL	GOVERNANCE	Distribution of stakeholders investing into design			
		ECONOMIC	Financial feasibility of neighbourhood to invest in design			
		CULTURAL	Capacity of design to effect behavioural change			
		SUMMARY				

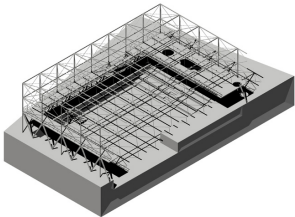
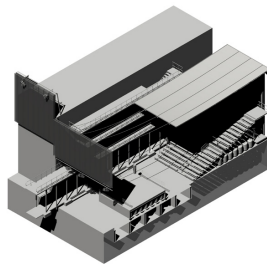
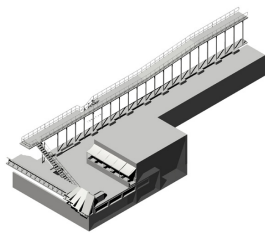
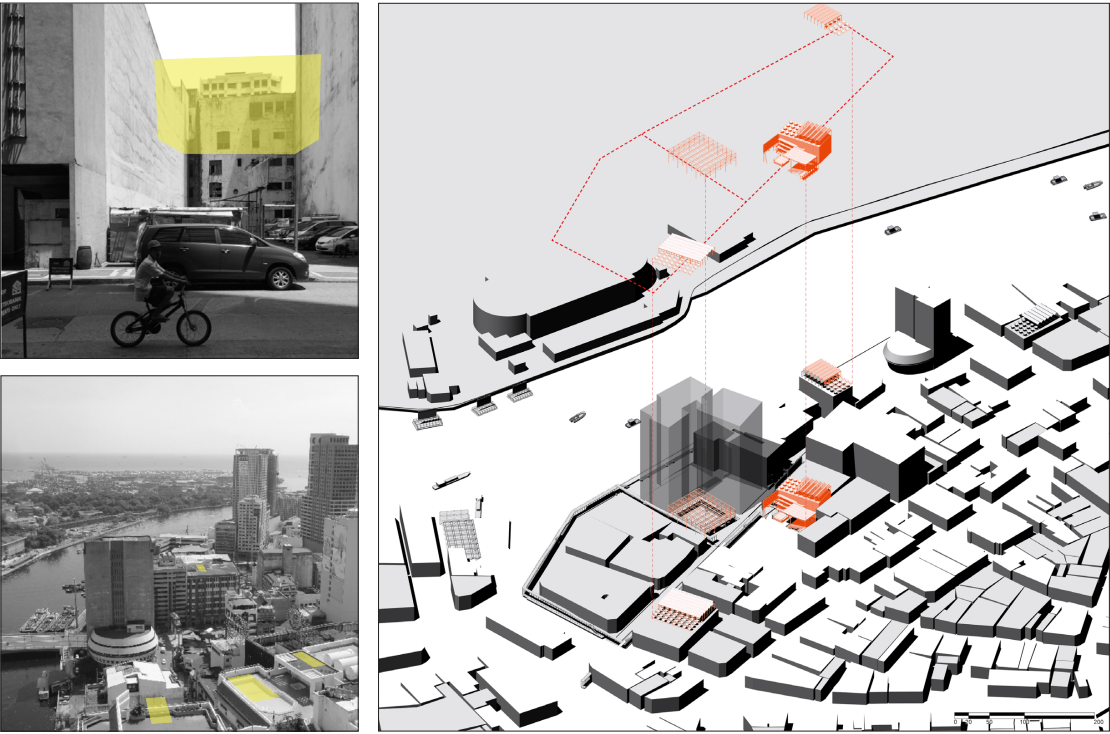
Figure 7-1 Evaluation Diagram

To evaluate the design interventions, the assessment (see figure 7.1) was broken down into environmental, urban use and contextual indicators that brought about direct and indirect benefits to the test study sites: direct benefits were related to the environmental performance criteria during flooding: how well would the interventions respond to the speed and duration of flood events, and would the neighbourhood's physical connectivity be retained during the flood season? The indirect benefits considered the social value that designs could add to a neighbourhood, including the introduction of civic qualities, flexible urban programmes and making sites accessible to the wider community. In addition, designs were also considered against the background of contextual indicators, which speculated on the design's economic, political and cultural impact on a neighbourhood over time.

The above also suggests that the value of the design has two spatial dimensions. These will be considered specifically in this chapter. As contextual indicators can of course only be assessed after design application and over time, they do not form part of this evaluation.

The first spatial indicator – environmental flood performance – is quantifiable and can be measured directly in response to anticipated flood patterns. The second – urban performance – consists of intangible and qualitative components that can only be understood through reflective discourse. The drawings propose potential answers in response to flooding, and suggest what impact design might have in each neighbourhood. How well prepared is a neighbourhood for flooding of riverbanks and how vulnerable is the existing building stock to rainwater run-off and ponding? And how can design retain urban connectivity during prolonged flood events? The evaluation of the design proposals is not based on an engineering-oriented quantified form of assessment, but by successfully dealing with the flood-induced challenges, which reveals how design can introduce potential social and economic benefits to the neighbourhood.

The following section will consider the historic, post-industrial and informal sites in terms of their specific flood challenges and will evaluate the choice interventions in relation to the design strategies set out earlier in the study. It will then briefly discuss the merits of the interventions and the potential social benefits that are implied by design.



STAKEHOLDERS

Property Owner - Public/ Private  
Development - Public / Private

FINANCING

Profit/ Non-profit  
Government aid

PROGRAMME



LOCATION

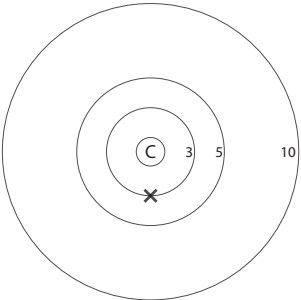


Figure 7-2 Evaluation of historic site (A)



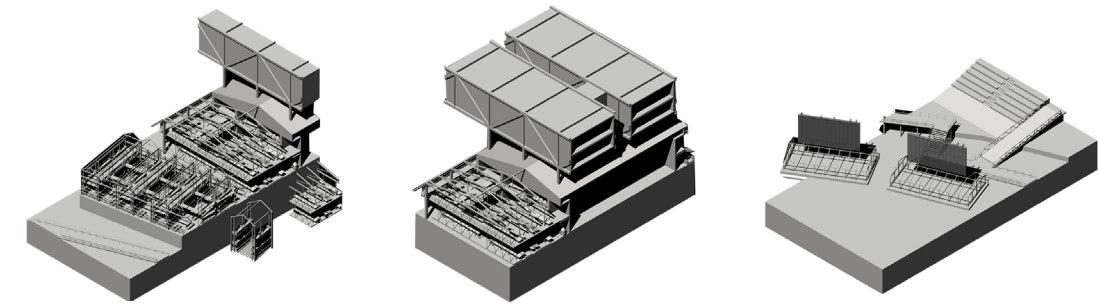
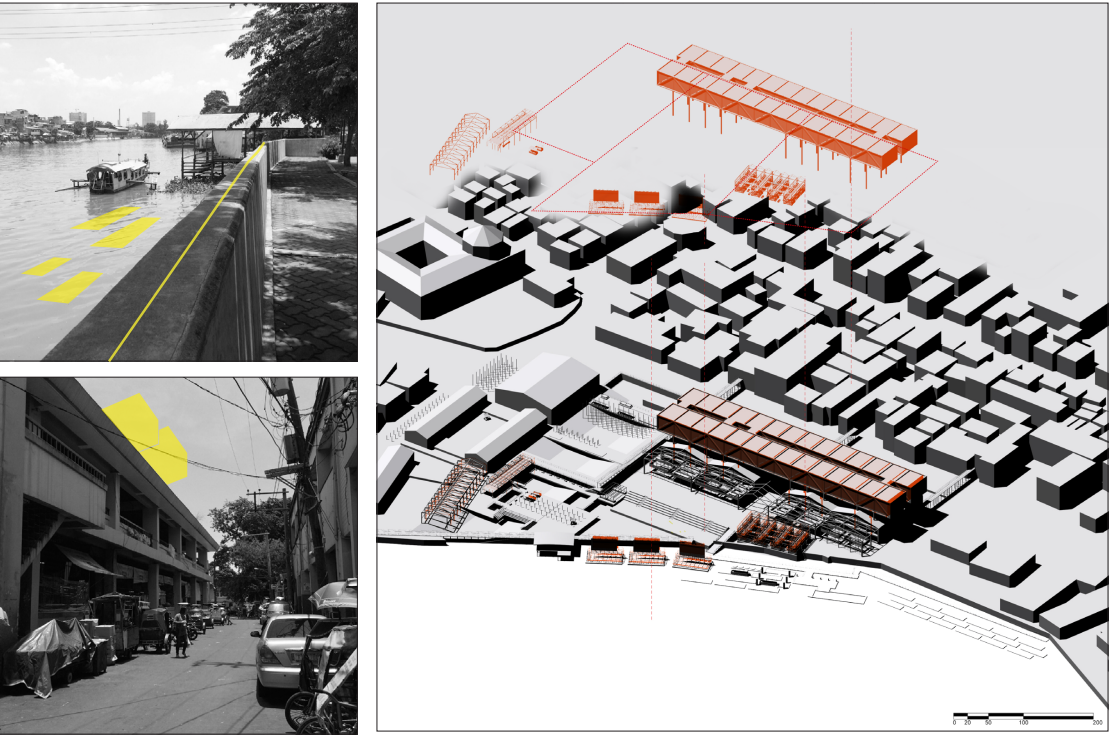
## 7.1 Spatial Performance: Environmental/Social Assessment

### **Historic Site (A) - Binondo**

In order to evaluate the benefits of the retrofitting strategy in the historic neighbourhood, the design project had to work with Binondo's existing system of flood protection (recently implemented floodwalls and floodgates). It took into account the risk of floodwater potentially getting caught within the floodwalls, which effectively could cause ponding and damage to buildings. The modernisation of out-dated pumping stations, part of Manila's flood management plan, only partly addresses this risk. Therefore, the priority for design intervention in Binondo was to deal with pluvial flood risk; to reduce flood depth and to keep the neighbourhood connected during flood events.

In order to retrofit the historic neighbourhood, the design strategy would need to revolve around complicated negotiations between the city and the different landowners of buildings and vacant lots. Any proposed design interventions therefore aimed to benefit multiple stakeholders. The plan to pedestrianize the river edge would act as a starting point to engage local community organisations and the local government in an effort to create a public riverfront. New terraces would be installed along the flood walls. This would attract new types of activity, such as urban street markets, and encourage building fronts to open up to the riverside. The local community groups could also be actively involved in the neighbourhood-wide plans to modify Binondo's urban gaps, neglected plazas and overlooked rooftops. The insertion of a new network for rainwater collection, would directly address the functional needs of the wider community, ranging from the water demands of individual buildings (grey water recycling) to the maintenance of local streetscapes (cleaning of street surfaces) and neighbourhood amenities (irrigation of community gardens). The upkeep of this system would further require active monitoring and management at a neighbourhood level. Prior to heavy downpours, for example, the onsite cisterns would need be emptied to make space for excess rainwater that otherwise would directly fill the local storm drains. In addition, the system of covered walkways, which would provide higher-level access to the different buildings during prolonged flooding, could also be maintained through local community groups.

While the network of rainwater collection and raised walkways and could be seen as a functional framework primarily designed to cope with potential flood levels, it could also introduce new forms of urban programmes. The rainwater cisterns in Binondo's urban gaps



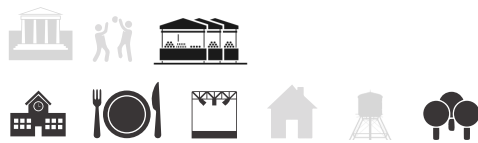
STAKEHOLDERS

Property Owner - Public / Private  
Development - Public / Private

FINANCING

Profit and non-profit  
No government aid

PROGRAMME



LOCATION

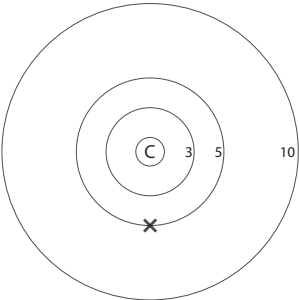
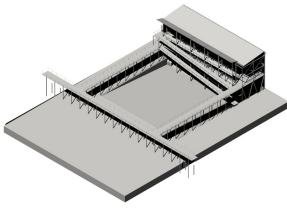
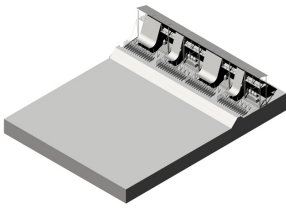
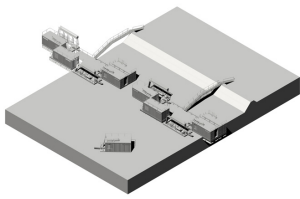
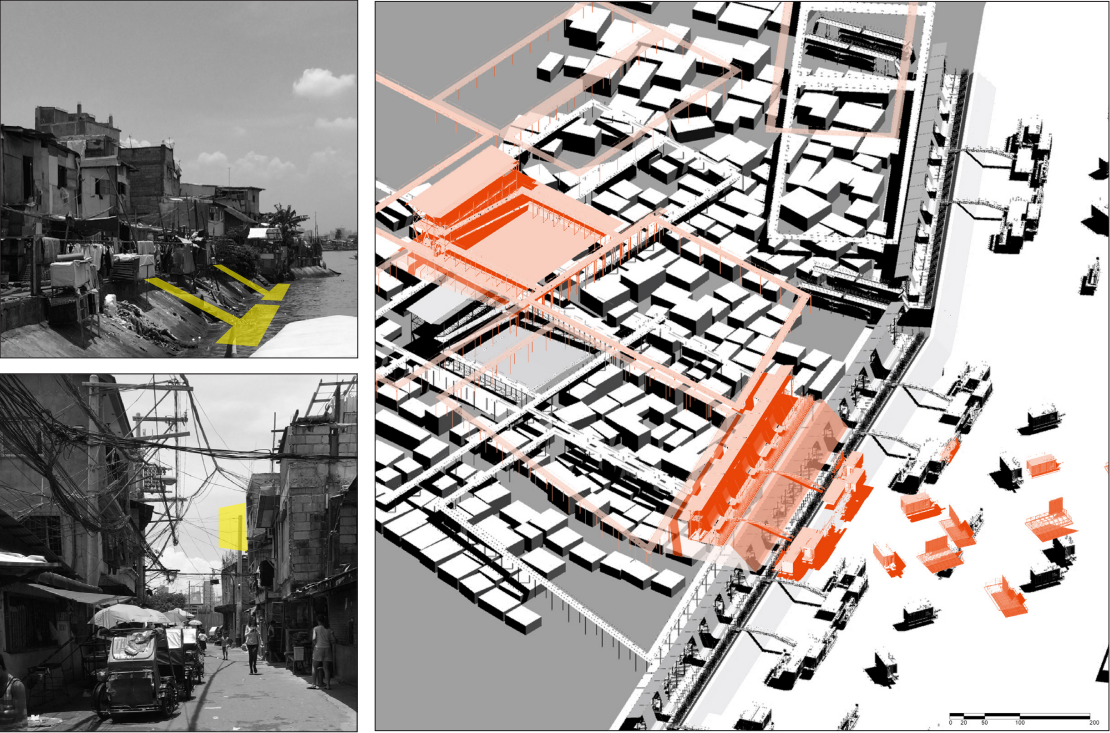


Figure 7-3 Evaluation of post-industrial site (B)

would create substantial areas for water retention. A surface area, for example, of a new basketball field (30 x 15 meters) raised 3 meters above ground could potentially hold 1,35 million litres of water, which replenished several times a year, could act as a vital resource at the centre of the community (refer to diagram of sample intervention, p. 123). The adaptation of Binondo's roofs, pockets and plazas would not only transform these surfaces into environmentally productive areas, but driven by local neighbourhood associations could be of educational value as well. The retrofitting of these urban spaces could be turned into effective training programmes that can provide the community with the knowledge, skills and resources toward sustainable water practice. On a whole, the different platforms would therefore function as urban catalysts with recreational and educational programmes bringing in a new social and economic dynamic at street level. Over time, these environmentally led adaptations would make better use of neglected urban gaps and revitalise Binondo's historic heritage.

### **Post-Industrial Site (B) – Santa Ana**

In Santa Ana the evaluation of the adaptive reuse strategy looked at the benefits small-to-medium rise developments could offer in comparison to the form of high-density building neighbouring areas are experiencing. The reclassification of the district from 'industry' to 'medium' intensity, suggested a wider range of options to develop Santa Ana's riverbanks that no longer are reliant on the existing dyke construction. While these types of flood protection were put in place to protect former sites of industrial production, the flood risk from river overflows would simply be shifted further downstream (Kendrick 1988). Using Manila's flood maps to differentiate Santa Ana's flood-prone areas (due to local topographical depressions) from higher dry ground, the design project used the opportunity to determine which areas would be viable for redevelopment, and which ones would be best kept free. In comparison to the historic neighbourhood, more ground for larger scale transformation is available in the post-industrial area of Santa Ana, and with landownership claimed by the local government, a coherent field-like design strategy could be established. Through the careful strategic mapping of the area, the proposal aimed to find an optimum combination of 'grey' and 'blue/green' design solutions, which included 'making room for water'. In the most flood-prone areas the introduction of 'blue/green' surface solutions, such as bioswales, could counter the need for costly additional pipe work and at the same time reduce the operational load on existing storm water drainage networks (Fletcher et al. 2014). The introduction of new urban parks and water channels was also seen as a more sustainable option for flood adaptation that at the same time would enhance local biodiversity .



STAKEHOLDERS

Property Owner - Public / Private ?  
Development - Public / Private

FINANCING

Profit/ Non-profit  
Government aid

PROGRAMME



LOCATION

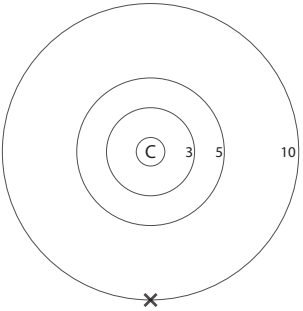


Figure 7-4 Evaluation of informal site (C)



By following the site's natural topography, the areas at highest flood-risk in Santa Ana were designed as parks or water basins that would be used for leisure activities during dry season and flood storage during heavy rainfall. The edges of these parks would also be defined by soft berms, which would filter and then channel the water around the ground into smaller neighbouring community gardens, keeping the remaining ground dry for new development. A diverse use of the post-industrial ground was further encouraged through a combination of vernacular building typologies, such as seasonal floating gardens or amphibious markets that would be able to respond to different water levels. With the city's amount of green spaces at 5 square metres per person, Manila is currently well below the Asian average of 39 square metres (Asian Green City Index 2011). The development of more public and green areas could therefore revitalise the river edge and act as a direct response to Manila's lack of public and green spaces.

To develop these types of public space, the project would require new forms of public-private partnerships. The government could, for instance, agree to release partial property rights of areas on higher ground to private developers and co-invest profits into the flood adaptation of the remaining areas. This could result in the development of parks of different sizes and formality, and the new combination of medium-rise development and public space could also potentially boost the value of any the surrounding neighbourhood. Alternatively, the government could retain landownership and rent out spaces to private development. This would of course require more communication between the different stakeholders, while allowing the government to retain control over any future development.

### **Informal Site (C) - Punta**

In Punta, the evaluation considered the benefits of the different types of 'slum upgrading' strategies. The design project first needed to address the lack of flood protection in the informal neighbourhood. Environmentally-led flood adaptation was applied to redefine 10-metre easement along the Pasig's riverbanks that regularly flooded several times a year (Zoleta Nantes 2002). With families regularly forced to move to evacuation centres during flood events (Asian Disaster Preparedness Center 2008), the design project also considered the systematic upgrading of the neighbourhood and the potential for onsite rehousing. The study therefore explored how effectively the design strategy could reduce the speed of potential floods, deal with prolonged periods of flooding and restructure parts of the neighbourhood over time.

By reorganising the river edge into different bands of flood risk, the project was able to map out the areas that required vital flood protection, as well as the position for community shelters and evacuation routes. The soft landscaping on the riverbanks became an essential part of the upgrading of Punta. The proposal would be to only partially pave the easement and to leave the rest for planting schemes at the initiative of the local neighbourhood. By planting bamboo and trees to attenuate the force of potential floods, the flood risk zone would be transformed into an environmentally productive zone. In form of linear parks, the zone could be further be transformed into community gardens and fields for local food production, introducing a new vitality along Punta's riverbanks and much needed space for social interaction.

The process of slum upgrading was based on two key principles: retaining the local community and engaging the community in the design process. Emphasis was therefore placed on local onsite resettlement to preserve existing micro-economies and social ties. The temporary relocation of families onto floating shelters would enable necessary redevelopment work to be conducted, but would ensure the local neighbourhood network to be maintained. The proposed upgrades focused on making improvements to the river edge and existing streetscapes that would allow for the upgrading of people's houses and workspaces and define locations for communal buildings and evacuation routes. The development of raised walkways could form part of the physical framework to densify vertically and to transform roofs and outdoor spaces into places of work and social interaction. With the construction of new community evacuation centres and shaded walkways, new focal points for the community and spaces for social interaction would be created for the neighbourhood.

During an interview conducted on 24 February 2016, civil engineer Priti Parikh pointed out that Punta could learn from other informal settlement improvement projects, such as the Slum Networking in Indore City, where roads were innovatively converted into storm water drains for surface water. In the process of upgrading the streets and inserting new physical frameworks in the neighbourhood, different types of demolition and reconstruction would be anticipated, but by allowing the residents to stay, the social and economic networks would remain intact. The upgrading strategies of planting of trees, resurfacing of neighbourhood roads would also be combined with the construction of community facilities that could be used for education, training and flood shelter. The introduction of such facilities would further create community-oriented programmes and amenities that can strengthen Punta's local social network.

## 7.2 Reflections on Design and Context

### LANDOWNERSHIP AND POTENTIAL INVESTORS OF DESIGN

Site	Population	Landownership	Potential Investors
<b>A</b> Historic Binondo	5,527	Private	Public
<b>B</b> Post-industrial Santa Ana	6000	Public	Private
<b>C</b> Informal Punta	15800	Contested	Local /Public

The examples of Binondo, Santa Ana and Punta show how interventions through design can address some of the environmental challenges of flooding. At the same time, such interventions imply potential social and economic benefits for the different neighbourhoods. The designs for the three sites suggested a range of interventions from small-scale insertions, redesigned public spaces to entire new ecological networks. The interventions also explored temporary to permanent-, planned and unplanned adaptations to the existing urban fabric. But whether retrofitting historical plazas, adapting warehouse buildings or re-constructing river edges along the informal settlements, working and persuading local stakeholders and investors is key.

To examine the potential for conversion, the context analysis looked more closely first, into the local governance structures, and second, into the financial viability and likelihood for design intervention (Baum 2013): what was the role of potential stakeholders and beneficiaries of the design? And how could the design projects be funded and maintained in the future? These questions provided clues as to who architects and urban designers might have to approach, in order to initiate ecologically-minded change.

A closer examination of landownership showed that buildings and vacant sites fall under private ownership in the historic neighbourhood of Binondo (Guéguen 2010), the post-industrial ground in Santa Ana is 51% public land (Asian Development Bank 2016), and in the case of informal settlements, such as Punta, landownership rights often remain unclear (Constantino-David 2002). The study also looked at the number of residents in the area at flood-risk, as the principal stakeholders in this discussion: in Binondo and Santa Ana approximately 6,000 people respectively live within the flood risk zone, whereas in Punta this number is nearly

as high (Census of Population and Housing 2010). In all cases, the local municipality would have to play a central role in planning for flood adaption: in the historic neighbourhood to co-ordinate efforts between private landowners, in the post-industrial district to exercise a stronger regulatory role over any potential private-led redevelopment, and in the informal neighbourhoods, to mediate between community-initiated development plans and different streams of external funding. Lastly, the role stakeholders, communities and beneficiaries play in the design processes further is important to consider when thinking about the longevity of the design. Speaking about the necessary involvement of local communities in the design process architectural activist Alfredo Brillembourg from the Urban Think Tank maintains that, 'any intervention that is considered had to be organic, in the sense of enabling and requiring the direct participation of the residents. Sustainability in any context is not merely an issue of architectural and engineering design and of technology, but of operations and behaviours.' (Brillembourg 2013).

With Manila characterised by an extreme form of private-sector-driven urban development (Shatkin 2006) how feasible would it be to promote environmentally led design? And given the city's decentralised governance structure, little planning regulation and 'the virtual absence of metro-wide governing capacities' (Michel 2010, p.391), how likely would it be to implement design? Manila's high degree of privatisation may predominately favour the production of urban spaces for the city's upper-middle classes and continue to marginalise its informal communities (Michel 2010, p.399). But new models of urban development are emerging, with local government partnering with private developers having created design-led changes to local neighbourhoods. A handful of urban renewal projects, for instance, during Lito Atienza's time as mayor of Manila (1998 – 2007), led to the renovation of historic plazas and promenades that remain open to the wider public (Guazon 2013). More recently, the rehabilitation programme of Manila's canal waterways initiated in 2010 (Asian Development Bank 2010) can be regarded as a model case study for urban interventions led by private sector initiatives. The clean up of a local Pasig tributary was developed in parallel with the renovation of a local market and the building of a new community centre providing new urban value to the locality.

So how feasible is it to involve future stakeholders with design? And who would designers side with in order to get design change off the ground? The recent development of 'public-private-partnerships' could explore public spaces that could be delivered and managed with the involvement of private organisations and that hold promise for future design interventions. In the case of Binondo, the design study could form a plausible basis for collaboration between



private building owners, community heritage groups and the local government. According to an interview with architect Dominic Galicia on 06 August 2015, local community groups are already actively involved in neighbourhood improvements. The small-scale water harvesting interventions could to begin with be initiated through private funding, and subsequently be grown to a neighbourhood-scale water management network with the help of public subsidies from the city. Combining the water systems with event platforms could potentially also generate income from private investors that could go toward the maintenance of the network. The design implementation could also turn into a neighbourhood-training scheme that could educate the community, planners and designers with knowledge on retrofitting and water management.

In Santa Ana, the study also suggests how public-led adaptive reuse could regulate private-driven redevelopment along the Pasig's post-industrial areas. By balancing new mixed-use developments with a provision for open urban parks, the public-private partnerships could make significant contributions to new types of river edge ecologies. This would not only lead to a more holistic flood management strategy along the Pasig, but also contribute to new urban value creation. Both studies for Binondo and Santa Ana, through retrofitting and adaptive reuse, aim to revitalise the city's existing urban grain. The interventions therefore work with the given context, transforming the sites' memories by giving them new value and meaning.

Apart from public-private partnerships, the study represents a decisive move to broaden the discussion of ecological urbanism to a larger segment of Manila's society. By focussing on the challenges flooding and urbanisation, it is critical for design to directly address the city's informal society. In the case of Punta, contested landownership between the government and private owners could be managed through a trust community land trust that would consist of community members of the neighbourhood association and representatives from the local government. The proposed incremental changes, that range from temporary relocation to longer-term upgrading, are presented as practical and realistic solutions, which reflect the recent shift in how Manila is dealing with informal communities. As journalist Kate Hodal (2013) observes,

Possible solutions include NGO-led medium-rise resettlements on donated and foreclosed lands, community-managed mortgage schemes allowing for in-situ development, and private sector-funded relocation endeavours on entrepreneurial farms. All of these efforts spring from a blend of formal and informal – the government has a stake in each of them, signalling a sea change in its willingness to try new ideas.

If the government, private sector and community groups are able to construct new partnerships, a last question might be how likely it is for ecological change to be implemented. The key for change is the incremental nature of the design proposals. It is at this neighbourhood scale and the step-by-step improvements where the study sees the value of in terms of design impact. In all cases the proposals were imagined as small-scale manoeuvres, which over time and with sufficient funding could systematically be deployed through more formalised strategic planning. The designs therefore respond to everyday needs through smaller interventions. They need not be big or costly, but more attention needs to be paid to how the interventions are able to connect to each other, how these can spread and be multiplied. It uses design as a tool to guide and accumulate small actions, which aim to transform the bigger picture.

From the perspective of the local communities, the design proposals act as a starting point to inform different forms of discussion: to re-organise the informal neighbourhood together with the public sector, to retrofit the historic quarter with local government, and to adapt and reuse the post-industrial ground with the help of private investors. The design study can therefore be seen as a critical instrument by which different stakeholders can begin to work together. Through ecological urbanism the care for the local natural and built environment therefore forms a shared idea and shared practice toward the development of common ground.

The ecological design provides the necessary platform for communities and urban designers to commit to a common narrative. The value of ecological urbanism is as much in the ambition to create of shared natural and artificial ground, as it is in finding imaginative ways of connecting different communities and stakeholders to shared resources. Seen through this lens, the re-organised ground, through public buildings, urban spaces and fields, becomes common good, shared property and shared responsibility. The value of ecological design therefore lies in providing the overarching concept to bridge environmental functionalism with civic identity. It provides the practical tools toward shared action to intervene in Manila's flood edges with the ambition to leave them better.

- Blank Page -

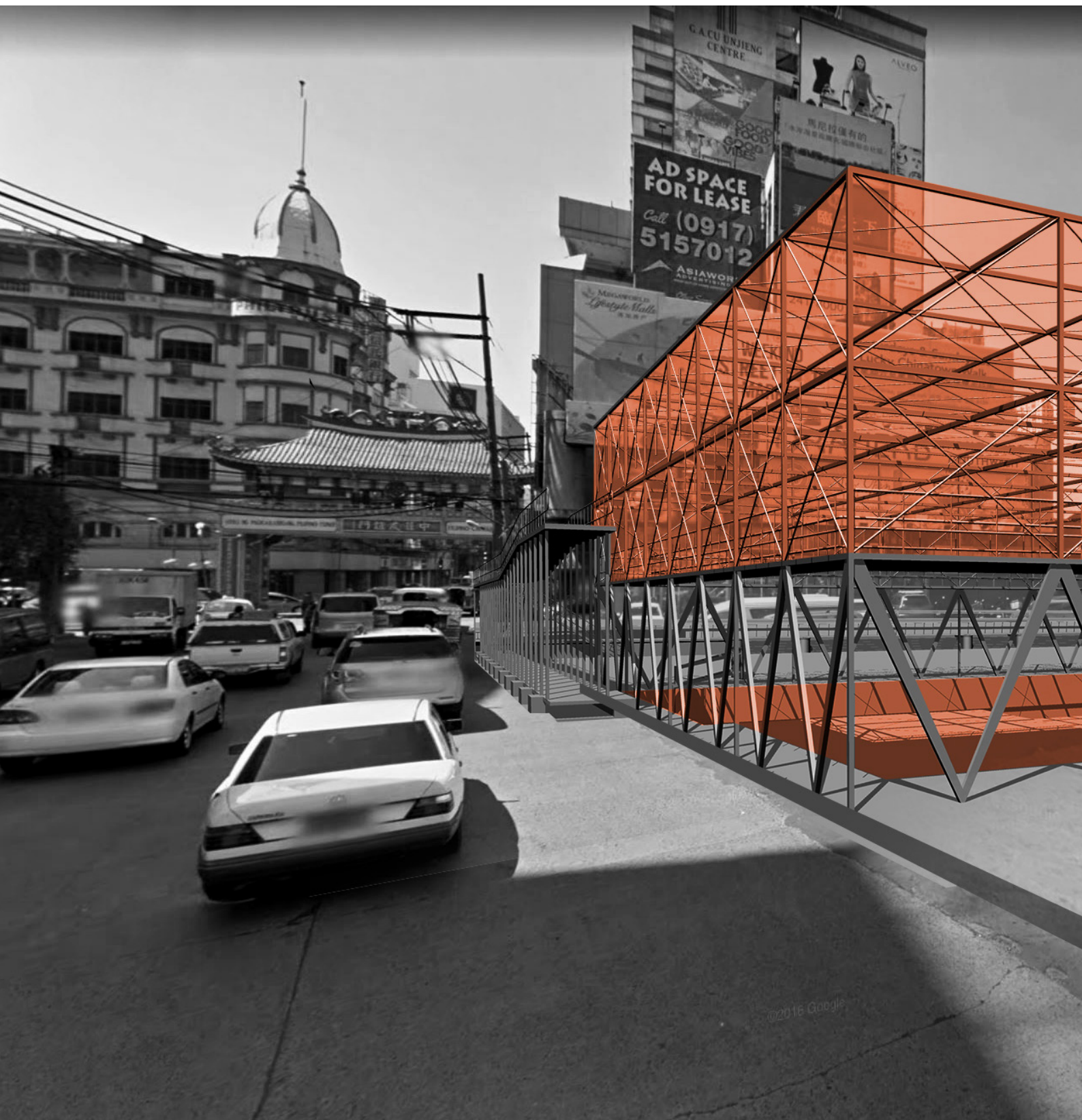


Illustration 7-2 Collage of covered water square in the historic quarter of Binondo



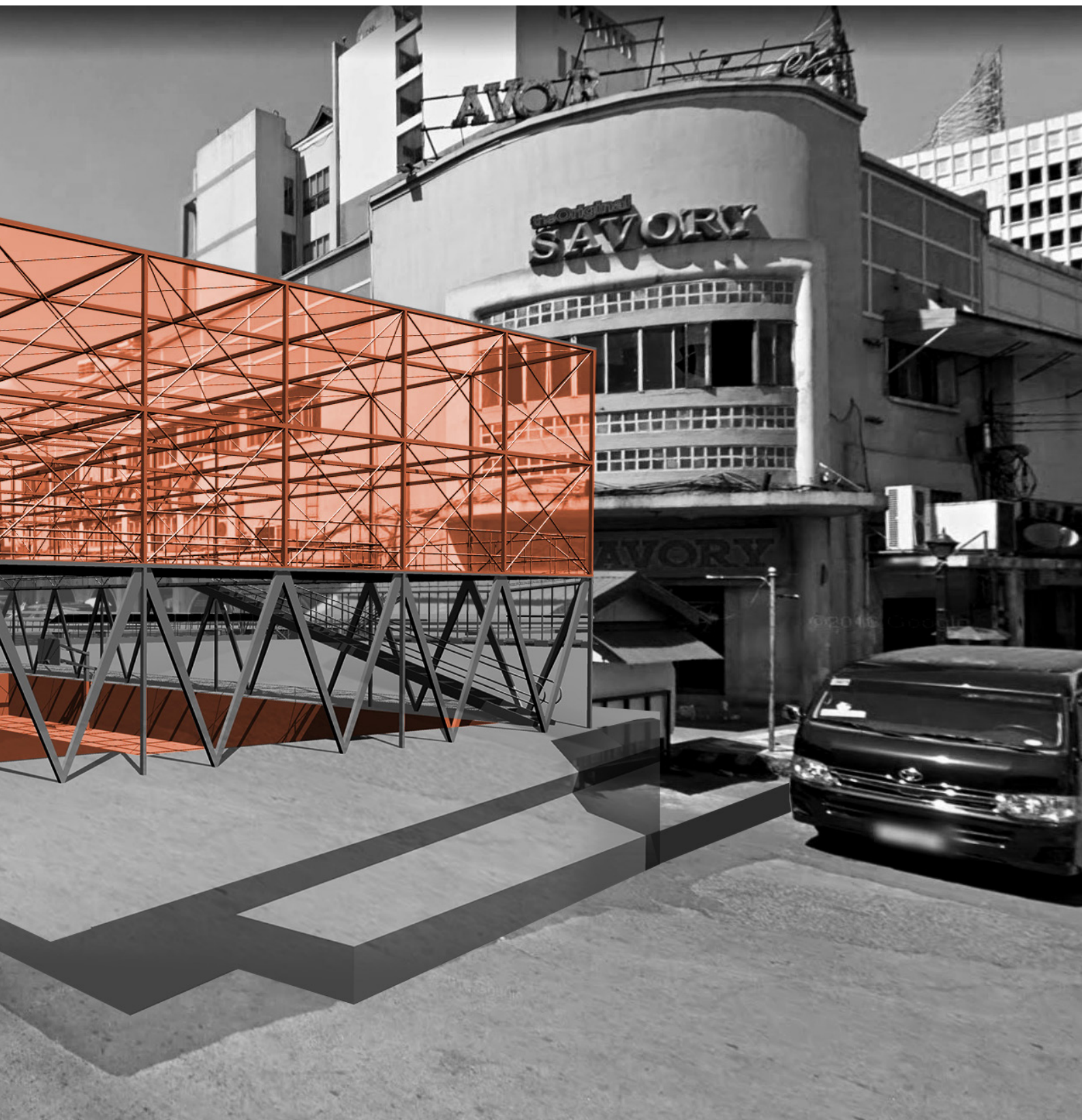




Illustration 7-3 Collage of raised buildings over existing urban grain in the post-industrial neighbourhood Santa Ana



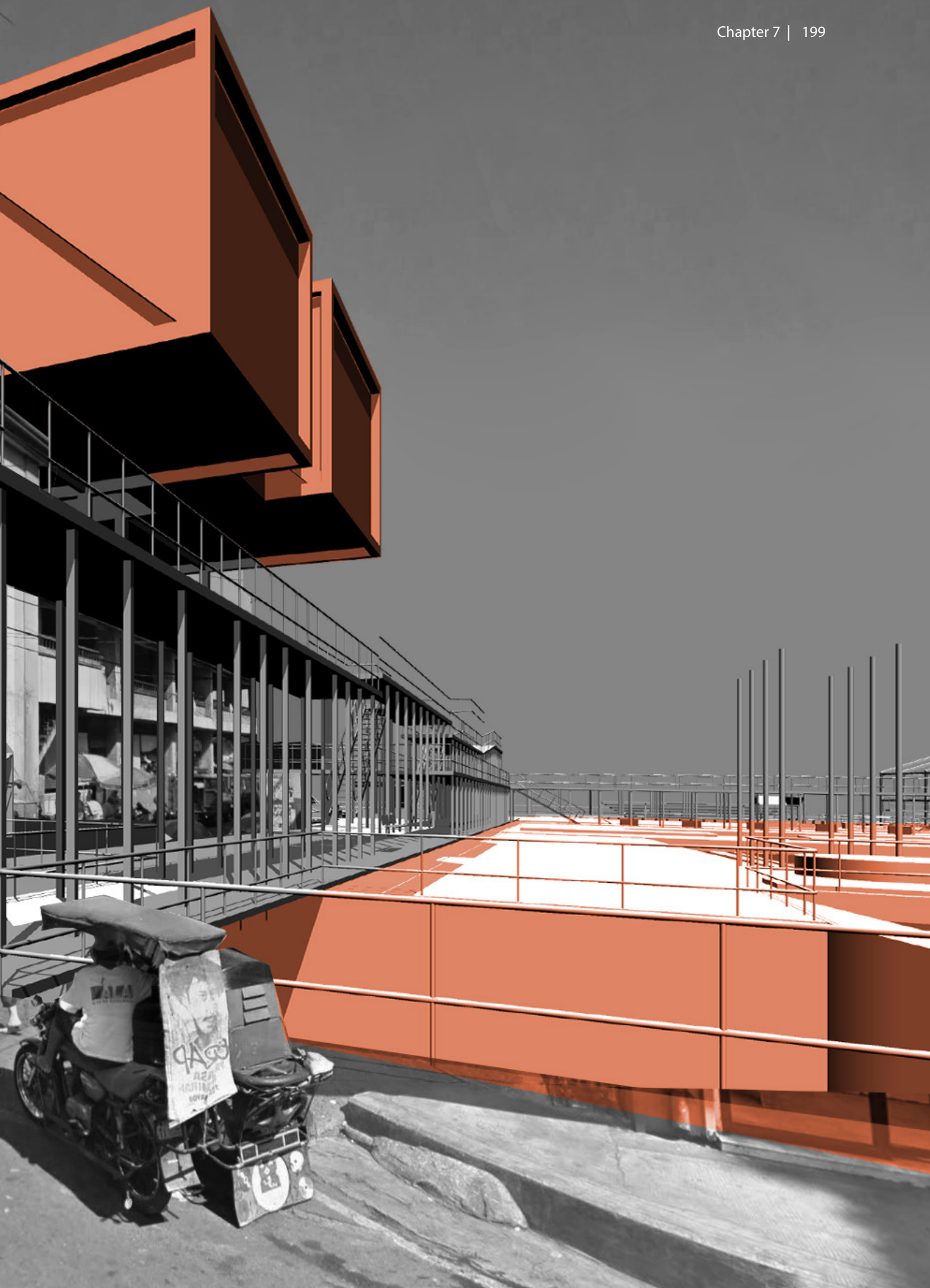




Illustration 7-4 Collage of temporary floating housing with flood protective berm in informal neighbourhood Punta







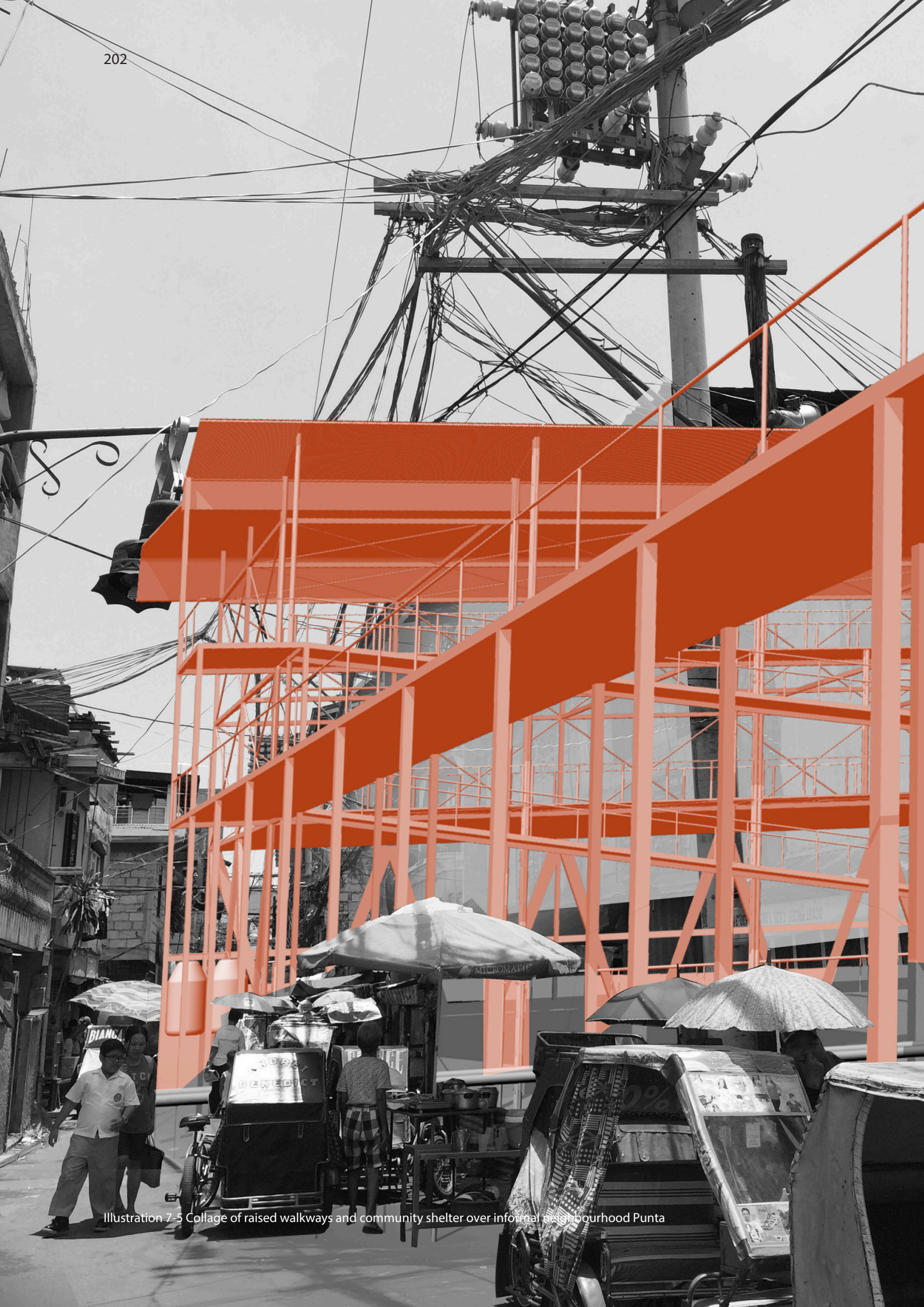


Illustration 7-5 Collage of raised walkways and community shelter over informal neighbourhood Punta



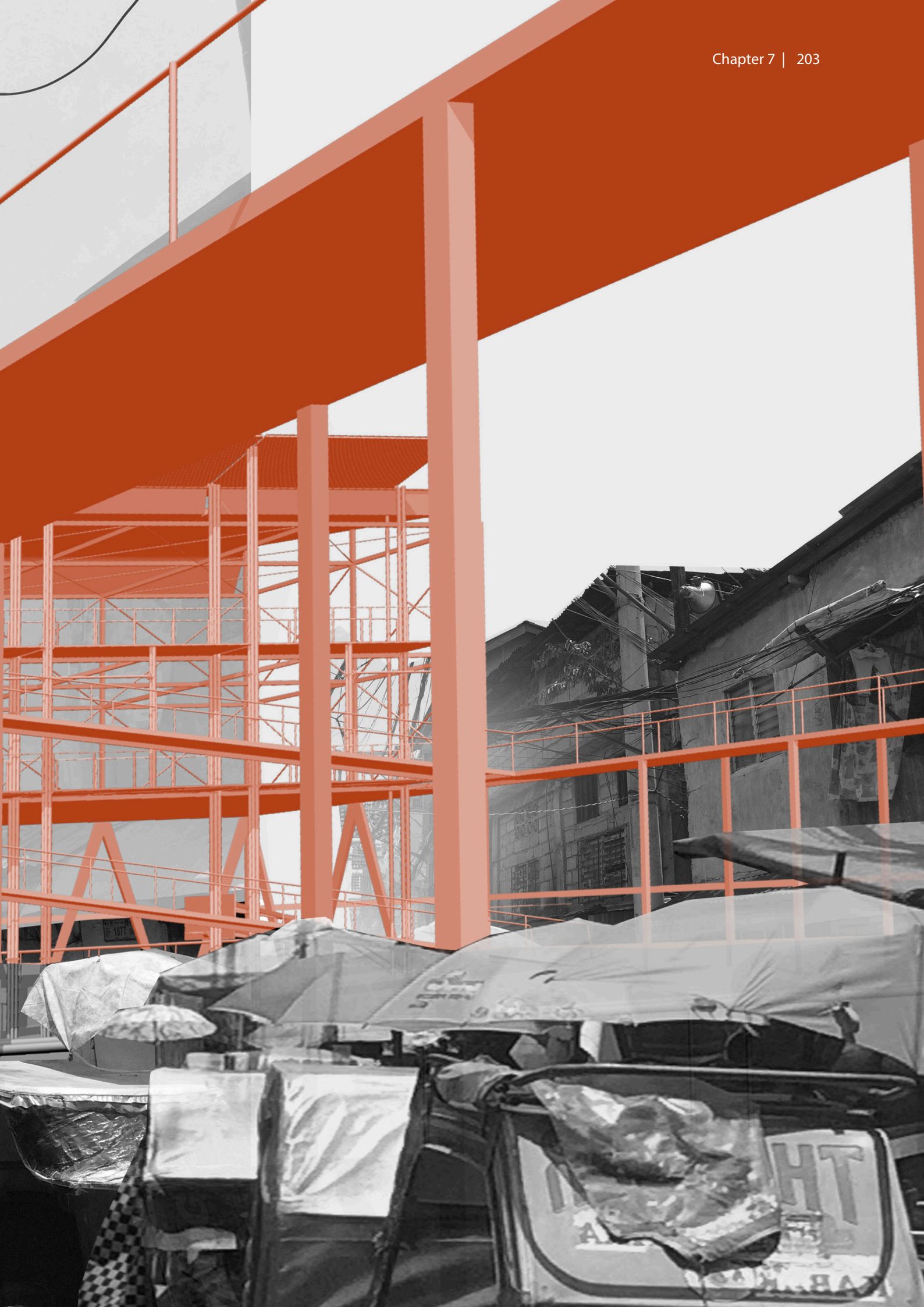






Illustration 7-7 Overview collage of tactical interventions. From bottom to top: informal, post-industrial, historic neighbourhoods and interventions





## Chapter 8: Conclusion

This thesis set out to develop flood adaptation strategies for Manila by design that would to some extent be transferable to other cities in the global south. The main goal was to examine the role design and the designer can play in the transition toward a flood-responsive city, which was pursued through a study that employed concepts and methods from ecological urbanism. The potential transformation of Manila's flood zones described in the previous three chapters was informed by the environmental and urban forces that continuously shape the city. With conventional top-down flood management approaches unable to deal with the complexity of the forces that define the flood edges of the Pasig River, this design research contributes to a more comprehensive and integrated approach to architecture and urbanism, which can not only be applied to cities like Manila, but also to other cities in the global south.

Design presented the opportunity to establish and retain connectivity of the city's communities at flood risk. The design proposals in this thesis, characterised by generic design strategies and particular adaptations, were demonstrated through a range of tactical interventions from local open spaces and neighbourhoods to larger river redevelopment strategies. Informed by projected flood, occupation and development patterns, both the choice of designs and their projected impact were shaped by the framework of ecological urbanism.

To understand the transition toward ecological adaptation approaches, the conclusion referred to Mostafavi (2010) and Hagan's (2015) writings on Ecological Urbanism, which highlight the urgency of integrating environmental thinking into the urban designer's repertoire. Recent studies further suggested that the combination of multifunctional solutions to Manila's flooding could yield greater benefits for the city's urban ecosystems (Asian Development Bank 2014). While the risk of flooding in Manila could be perceived as a natural hazard, accepting that it is also the product of human action (Anne Whiston 2014) underscores the importance of a response via design.

A central argument of this research was that the design of ecosystems in the city could be instrumental through absorbing the effects of urban flooding and thereby making neighbourhoods more flood resilient. It proposed that ecological urbanism as a framework

for design could guide the conceptual understanding, practical intervention and imagined transformation of the flood zones along Manila's Pasig River. The research used design as its *modus operandi*, and explored possible links between the fields of multi-disciplinary research, governance and spatial practice. As a multifaceted discipline, design could synthesise knowledge from such diverse sources and establish a reciprocal relationship between flood management and urbanism.

However, in order to translate principles of ecological urbanism to urban flood zones and the context of Manila, particular methods of design needed to be employed. The study acknowledged that so far, large-scale master planning and top down interventionism have not provided effective solutions to Manila's more vulnerable neighbourhoods and communities. Instead of imposing change, the study applied methods of intervention that required sensitivity for the sites and communities they were meant to support.

The significance of the designs therefore lies in the process-led rather than result-driven methods of research. Rather than framing the design as an end product, the thesis placed emphasis on design analysis, experimentation and variation. In this light, the design drawings are to be understood as visual working tools to frame, test and propose innovations for Manila's flood sites with the potential to be realised. Ecological urbanism therefore enabled the development of a holistic approach informed by environmental, urban and social agendas that would be able to connect Manila's riverside communities to new types of ecosystems.

### **Lessons for Design from Manila – What design can do**

By reflecting on the processes of design, the aim is to illustrate the links between 'research by design' and the design outcomes that emerged as a result of it. As a process-led form of research, the design activities used to develop the ecological design proposals for Manila's riverbanks took different forms. Through iterative loops the designs evolved through analytical, explorative, strategic and propositional ways of working. This included learning from other cities that illustrate best-to-worst cases, developing tactics and strategies specific to a city like Manila, and testing potential design interventions that could relate to the particular conditions of each neighbourhood. With the emphasis on process, the study not only considered the individual proposals for the three sites that were chosen, but more importantly, also the totality of design work undertaken during the course of this study.

A brief summary of the relevant chapters reflects on some of the working methods from this study that will be relevant for future practices in architectural design and ecological planning. These are labelled as 'extracting', 'strategising' and 'layering'.

### **Extracting**

Conducting 'research into design' was an example of how design can draw lessons from other case studies. The analytical comparison of New Orleans, Dhaka and Hamburg in Chapter four provided the framework for a critical understanding of the environmental and contextual challenges of the design study, and for the preparation of possible design interventions that could respond to the Manila-specific context. The comparative study defined a sample range of approaches and technologies used in flood management practice that varied in terms of cost and environmental thinking. The comparison also established the necessary basis for an appreciation of particular socio-economic, cultural and political conditions that define any potential for future design intervention. Having applied these notions to the three local sites in Manila enabled the study to develop interventions that could respond to the challenges of a range of urban morphologies in parallel with each of their particular governance and development patterns.

The case studies provided practical examples about scalar, temporal and multi-disciplinary approaches that could be applied to Manila. In 'Designing Dhaka: A Manifesto for a better city', architect Kazi Khaleed Ashraf reinterpreted a series of spatial and urban typologies at different scales to depict a more flood-sensitive future Dhaka. Pathways, edges, nodes and landmarks were reimagined to express an interdependent correlation between landmass and waterbody. Set into the fluid floodscape, the proposed interventions would help develop new natural environments that could create new socio-economic patterns and establish a meeting ground for diversity. In the case of Hamburg, the phased development and flood adaptation plans for the Hafencity district acknowledged the need to incorporate flexibility in long-term projects. The combination of fixed basic design guidelines and operationally manageable rules is a strategic example of a successful application of the use of adaptable design principles to changing urban structures, programmes and growth predictions. While Hamburg's example of a large-scale top-down development cannot be directly applied to Manila's decentralised and uncoordinated planning structures, it provided an example of how urban development could be phased and strategically linked to the city's existing large-scale



flood management processes. In the case of New Orleans, the city's urban water plan showed how design could create the necessary platform (the Dutch Dialogues – see page 86) between different design professionals, policy-makers and local communities to bring water issues to the forefront of planning and design for the city. Involving stakeholders, community leaders and the public in New Orleans was key to bringing about a new paradigm in which storm water can be managed as a valuable resource and form a driver toward flood-adaptive planning and design. This has evolved into design-led urban development plans driven by the neighbourhood groups and the local design community.

### **Strategising**

Chapter five on 'strategies and tactics' provided a model for the type of conceptual and practical frameworks that need to be established in order to incorporate ecological thinking into the design process. This involved a two-step process: constructing an ecologically informed strategic framework from the reading on ecological urbanism and deducting a catalogue of tactical design components based on research into different design case studies.

The ecological strategy was based on a three-tiered framework that included environmental, urban and temporal aspects. Applied to the different neighbourhoods, this could be developed into site-specific strategies. The close link between flood management, urban intervention and their development over time was established to introduce ecological thinking into any potential future design. The strategies worked parallel to Manila's large-scale and state-led flood management plans, but more importantly, they were also sensitive to the specific working and conditions of each neighbourhood. 'Retrofitting' strategies were applied in the historic neighbourhoods, 'adaptive reuse' in post-industrial areas, and 'upgrading' elsewhere.

To develop a systematic approach to the challenge of flooding, the research developed a catalogue of flexible and modular design components that could be adapted to respond to specific challenges of any given locality.

The proposed design tactics used spatial components consisting of 'surface', 'building' and 'network' interventions. The purpose of paring back design into simple and repeatable elements would be to convince key decision-makers who might in the local political cycles only have three to six years for the implementation of a project. These kinds of prototypical

designs also would have the advantage of being implemented according to the particularities of a site and economies of scale. The possibility of multiplying prototypes also responded to the economic constraints of each neighbourhood. In the case of retrofitting Manila's historic neighbourhoods, the multiplication of rainwater harvesting tanks could bring down costs for production and implementation; as a field of interventions, the growth of such a network would over time contribute to local flood control through water harvesting.

### **Layering**

Chapter six was an illustration of testing of ecologically-driven designs at different scales, across different sites and over time. Through iterative processes of testing and reflecting, two themes emerged that can be used as instruments towards ecological transformation: scalar interventions and incremental networks.

### **Scalar Interventions and cost**

The weaknesses of large-scale implementation to date in Manila suggested shifting attention to smaller sites and more manageable scales of intervention. While the thesis acknowledged the importance of the city's engineering-led flood management plans, the local governance, financial capacity and urban character determined how the universal design strategies and tactics would translate into particular designs. The interventions targeted the intersection between the environment and the urban, spaces often of common ground in the interest of stakeholders – from local community groups to local government and private developers. The focus on the neighbourhood scale further enabled the identification of possible interfaces between top-down resources and bottom-up agency. Sites such as river promenades and public squares were regarded as common ground and test sites for urban acupuncture and urban resilience. Such projects could gain the support of local mayors, investors and the local community to gather on-going support for sustainable maintenance.

### **Incremental networks and time**

The smaller-scale urban interventions were seen as part of the longer-term strategies that could incrementally grow over time. Inserted into different urban contexts, the interventions would transform vacant lots, streets and rooftops into vital ecological pathways and fields. The new public spaces and buildings would also create new focal points for each of the neighbourhood. Unlike traditional urban nodes defined by the formality of grids and orthogonal lines, an ecological framework would create a more rhizomatic network that would weave through the urban fabric. While the historic city (Site A) would be punctuated

with water squares, lines of blue-green corridors were drawn through the post-industrial neighbourhood (Site B), the river edge of the informal settlement (Site C) would be re-lined with an urban park. These types of ecological landscapes were proposed with the intention to reduce flood risk, while at the same time contributing to the overall well-being of the different communities and to the health of the city.

### **On design drawings**

The drawings that emerged from the study were strategic plans, dynamic sections and superimposed moments. Seen in combination, they brought together different challenges and projections for the Pasig River. Tested and developed through a series of feedback loops, the designs were evaluated against the existing conditions on the ground and the overarching ecological strategies set for the neighbourhood. Through multiple viewpoints the drawings portrayed what could happen if the ecological concerns were to be addressed first, and suggested how the new common ground could be inhabited with future programmes.

The working methods of 'extracting', 'strategising' and 'layering' only represented a handful of working methods that could be considered in the design toward flood adaptation. The design drawings should not be read as descriptive illustrations, but as instruments that actively engage with the urban, natural and social environments they aim to represent. As landscape architect Linda Pollak maintains, 'the challenge in design is to develop ways of working that can support and represent a multiplicity of spatial identity, to bring into focus as (constructed) ground that which is usually relegated to background.' (Pollak 2012, p.128). The design proposals were therefore an attempt to highlight the concerns for nature and Manila's overlooked communities along the riverbanks of the Pasig.

### **Contextual Challenges for the architects and limitations – What designers cannot do**

As the environmental and urban challenge in the example of flooding in Manila has shown, new urban solutions are urgently needed to plan for the long term and work towards urban resilience. The design methods used in this study provided personal insights into how designers might begin to take on this challenge. The ecological framework described in the design project implies a way of working that architects and urbanists could adapt, and also an operative strategy to put ecologically-minded design into effect. But how can the ideas make it past the drawing board, and where do the limitations of design lie?

The diverse implications of the study of design in relation to floodscape urbanism leave considerable room for further study, in particular with regard to the role of the designer. With little governance, Manila's decentralised city structure lacks cohesion or co-ordination in its future development. Manila is not unique in this sense, and with more cities facing threats from environmental change and rapid urbanisation, it is fair to challenge the architectural profession to step up in leading on urban resilience (Hagan 2015). Their involvement can range from designing tactical interventions at a local neighbourhood scale to contributing to the development of environmentally-led strategies for the city. But in order for the designers to make a positive contribution, a change in paradigm is necessary. Architects and urban designers will need to shift their attention to the scale of the city, and at the same time, they will need to consider ecological thinking to make their contribution relevant. This will require new forms of practice and new forms of knowledge the designer will need to take on.

The challenges that the profession faces are two-fold. Firstly, by turning the profession's attention to the urban, the designer inevitably enters into complex discussions with the community, local government and other potential stakeholders, which conventional design, in terms of architectural design, does not necessarily deal with directly. Secondly, the profession needs to question whether it is equipped with the necessary ecological knowledge in order to make their contribution relevant to the discussion of the 21<sup>st</sup> century city. At some level, and to some degree this will require the architect to engage politically in the wider discussion of urban and ecological change. There is scope for further research to look how we can move towards an ecological responsibility in architecture and architectural education.

### **Exploring current practice**

The project examples of Manila provided clues as to who and at what scale the architect might begin to engage with. To move toward more environmentally balanced urban model, the different neighbourhoods and the local communities need to be mobilised. While one of the challenges toward ecological change might be a matter of finding the right types of funding, the process for the designer will need to start with gaining the trust and support from the right combination of community groups, and public and private stakeholders.

In order to know who to engage with, the architect's starting point could be to ask, 'whose territory is this? Who owns the resources?' For any design-led interventions to take place,



new alliances with the key decision makers need to be forged. This might require speaking to top down institutions and to offer planners and private developers alternative ways of delivering design-led change. But it might also mean advocating for the neighbourhoods and sections of society that are currently overlooked in the discussion of urban improvements. To engage with ecological change in the city, designers will need to take on new roles of mediators and participators. Further research could look into participatory design processes that provide localities with the means to identify potential toward ecological change through alternative ways of looking at problems and offering alternative solutions.

Further study could also look into how learning from contemporary action-driven practice can provide insights into engaging different communities and stakeholders with the process and value of design. This can be done by focussing on tactical, small-scale but systematic interventions and improvements; tools the architect and the urban designer can use and participate and to provoke change. As architect activist Teddy Cruz argues, 'this desire amounts to a redefinition of the architect-citizen and the citizen-architect, defined less by a professional identity, and more by the willingness to construct a course of action, a way of thinking, a new interface with a public culture' (Cruz in El-Khoury 2013, p.272). While urban designers or architects perhaps cannot design social constructs, equipped with environmental knowledge and imagination, they can help develop the physical conditions and structures to shape thriving urban environments that can adapt to environmental change.

The challenge for the architectural profession is to define a renewed relevance in the urban discussion. It is through ideas of ecological urbanism that the discipline is able to engage with a broader set of issues of the built environment and different fields that are related to this.

### **Exploring future education and research**

Apart from looking to expand the practice of architecture, we also need to introduce the ecological agenda into architectural education. This shift must start by challenging how we prepare the current and the next generations of designers with ecological change in mind. Environmental, social and cultural responsibility needs to return to the forefront of contemporary architecture as mainstream attributes, and today's design students, as future practitioners, will need to become increasingly versed in multidisciplinary approaches. Placed into today's context the 'demand... [for] a transformed and renewed access to urban life' (Lefebvre, cited in Kofman and Lebas, p.158) should be translated to gaining access to

the living systems in the urban context – the natural and the social. Bringing environmental and social agendas to the forefront in our design education will directly engage the next generation to confront, expose and address the ecological challenges of many contemporary yet neglected urban conditions.

A step toward the ecological urbanism project is to challenge students to experience and explore the environmental issues of the 21<sup>st</sup> century city. Cities that need to adapt to climate change offer a rich repository for necessary experimentation and research. Teaching the environmental know-how, as well as on-the-ground research of the contemporary urban condition, would give students the necessary understanding of the multiple challenges of the city. Combined with the creative setting of the experimental studio, this could offer an imaginary testing ground for the formulation of alternative ecological concepts, and for the development of critical responses through design. Reading, testing and reimagining environmental and urban realities are strategies that present a shift away from simply relying on theories of urbanism, and instead demand innovative responses through the practical interaction with the city.

The imaginative engagement with the 'real' is important, as it injects a sense of purpose into the active learning environment. Some institutions are already pointing in this direction. In the case of the Urban Think Tank and their work at the ETH in Switzerland, students are engaged with the 'real world' through 'live' projects, and work with actual situations in different global settings (Urban Think Tank 2010). Working in actual situations in the city requires students to expose how urban systems work and, importantly, how decisions are being made, in order to identify what types of collaboration are needed to influence urban change. With the city as testing ground, the opportunity to work across different sectors and design disciplines will of course challenge the architect and urban designer to continue to define their own disciplinary contribution. An emphasis on ecology and the city is a challenge for students to step up to societal and environmental issues through design.

This brings us to the final point, namely the role of the designer and new urban and ecological imagination. The agenda for nature and the city needs rethinking. The urgency of the matter, as presented in this thesis, requires innovative ways of thinking and designing that are at the same time bold and sensitive. In the case of flooding and urbanism in Manila the research was rooted in the city's present context. The research study provided the environment to address such this contemporary condition and to aim to produce work that

matters. From the point of view of design, the design process was structured by environmental necessity, but layered with the social and cultural concerns that are specific to the city. Both the tactical interventions and the larger-scale strategic moves play their role in creating renewed environmental and urban connections. As the thesis showed, in some cases small-scale changes provide the opportunities for urban communities to change their environments. In others, it is about creating larger scale moves that create new qualities of collective life – public space that as James Corner argues contains ‘the collective memory and desire’ (Corner 2006) of the city.

What the city is and what it can become can be bridged by ecological urbanism. It is through the narrative of water and the city that new types of fluid ground can be created that can host the memory of the river and the desires of the communities. This sets the stage for a new kind of designer, who understands the history of a place and who can synthesise this with knowledge of the city and the environment. It is potentially through combined environmental and urban scholarship that these narratives are brought closer together. It will demand new forms of knowledge that will help to continue designing and imagining.

- Blank Page -



## Bibliography

- Aerts, J ed. 2011. *Climate adaptation and flood risk in coastal cities*. London: Routledge.
- Aerts, J, Botzen, W, Bowman, M, Ward, P, Dircke, P eds. 2012. *Climate Adaptation and Flood Risk in Coastal Cities*. New York: Routledge.
- Alcazaren, P, Ferrer, L and Icamina, B. 2011. *Lungsod Iskwater: The Evolution of Informality as a Dominant Pattern in Philippine Cities*. Pasig: Anvil.
- Alcazaren, P. 2016. A plaza and a traveling fountain. Philstar.com [online]. Available from: <https://www.philstar.com/lifestyle/modern-living/2016/02/26/1557057/plaza-and-traveling-fountain> [accessed 16.08.2016].
- Alexander, C, Ishikawa, S, and Silverstein, M 1977. *A Pattern Language: Towns, Buildings, Construction*. New York: Oxford University Press.
- Alejandro, RG. 2000. *Pasig: River of life*. Manila: Unilever Philippines.
- Allen, S. 1998. Artificial ecologies. *El Croquis*. 86, pp 26–33.
- Allen, S. 1999. *Points + lines: diagrams and projects for the city*. New York: Princeton Architectural Press.
- Anjaria, JS, Bartling, H, Fisher, CT, Flaherty, J, Harvey, DC, Lara, F, Manaugh, G. eds. 2008. *What is a City?: Rethinking the Urban After Hurricane Katrina*. Athens, GA: The University of Georgia Press.
- Aquilino, M. ed. 2011. *Beyond Shelter: Architecture and Human Dignity*. New York, NY: Metropolis Books.
- Architecture for Humanity. 2006. *Design Like You Give a Damn: Architectural Responses to Humanitarian Crises*. Thames and Hudson.
- Architecture for Humanity. 2012. *Design Like You Give a Damn 2: Building Change from the Ground Up: Building Change from the Ground Up*. New York: Abrams.
- Aravena, A, Lacobelli, A. 2012. *Alejandro Aravena : Elemental: Incremental Housing and Participatory Design Manual*, Bilingual edition. ed. Ostfildern: Hatje Cantz.
- Arup Foresight, n.d. *Drivers of change*. Available from: <http://www.driversofchange.com/tools/doc/> [accessed 23.10.16].
- Ashraf, KK. 2012. *Designing Dhaka: A Manifesto for a Better City*. Dhaka.
- Asian Development Bank. 2002. Annual Report. Singaport: Tien Wah Press.

Asian Development Bank, 2012. *Design of a Pilot Project to Improve Environmental Conditions of Estero de Paco*. Available from: <https://www.adb.org/projects/46308-001/main> [accessed 21.07.2015].

Asian Development Bank, 2014. *Unflooding Asia*. Manila: IWA Publishing.

Asian Disaster Preparedness Center (ADPC) 2006. *Integrated Flood Risk Management in Asia*. ADPC

Asian Disaster Preparedness Center (ADPC). 2008. *Flood disaster mitigation and river rehabilitation by Marikina City, Philippines*. In: *Safer Cities 22*. [online] Available from: <http://www.preventionweb.net/files/globalplatform/entrybgpaper~SaferCities22.pdf> [Accessed 24 August 2014]

Asian Green City Index. 2011. *Assessing the environmental performance of Asia's major cities*. Munich: Siemens AG

Balgos, B et al. 2015. *Preparing Metro Manila toward urban resiliency: Prospects and retrospect* - UNISDR United Nations Office for Disaster Risk Reduction.

Balgos, BC. 2016. *Securing the Safety of Informal Settler Families Along Waterways in Metro Manila, Philippines: Government-Civil Society Organisation Partnership*. *Disaster Governance in Urbanising Asia*. Singapore: Springer , pp. 177–193.

Balica, S, Wright, N, Meulen, F, 2012. *A flood vulnerability index for coastal cities and its use in assessing climate change impacts*. In: *Natural Hazards 64*, 73–105.

Bankoff, G. 2003. *Constructing Vulnerability: The Historical, Natural and Social Generation of Flooding in Metropolitan Manila*. *Disasters 27*, pp 224–238.

Bankoff, G. 2003. *Cultures of Disaster. Society and Natural Hazard in the Philippines*. London: Routledge.

Bankoff, G, Hilhorst, D, Frerks, G. eds. 2004. *Mapping Vulnerability: Disasters, Development and People*. London: Routledge.

Barker, R, Coutts, R. 2016. *Aquatecture: Buildings Designed to Live and Work with Water*. Newcastle upon Tyne: RIBA Publishing.

Bartling, H. 2008. In Steinberg, P, Shields, R, 2008. *What is a city?: rethinking the urban after Hurricane Katrina*. Athens, GA: University of Georgia Press.

Bauer, U. 2008. *Das Verhältnis von Stadt und Fluss neu definieren: Die HafenCity Hamburg*. *Standort*. 32 (2), pp.40–44.

Baum, M, Christiaanse, K. 2012. *City as Loft: Adaptive Reuse as a Resource for Sustainable Urban Development*. Zürich: GTA Publishers.

BBC, 2012. Shanghai tops “flood risk list.” BBC News. [accessed 10.03.13].

Bélanger, P ed. 2016. *Landscape as Infrastructure: A Base Primer*. New York: Routledge.

- Bell, B, Wakeford, K, 2008. *Expanding Architecture: Design as Activism*. New York: Distributed Art Publishers.
- Benedict, MA and McMahon, ET. 2006. *Green Infrastructure: Linking Landscapes and Communities*. Washington, D. C.: Island Press.
- Bergdoll, B, Nordenson, G. 2011. *Rising Currents: Projects for New York's Waterfront*. New York: Museum of Modern Art.
- Berger, A. 2016. *Scaling Infrastructure*, New York: Princeton Architectural Press
- Berkhout H. 2002. Socio-economic futures in climate change impact assessment: using scenarios as 'learning machines'. Tyndall Centre Working Paper No.3. Norwich: Tyndall Centre for Climatic Change Research.
- Berlanda, T. 2014. *Architectural Topographies: A Graphic Lexicon of How Buildings Touch the Ground*, New York: Routledge.
- Brillembourg, A. 2012. *Torre David*. Lars Müller, Zürich.
- Brillembourg, A and Klumpner, H. 2010. Southern Exposures: Towards a Social Responsibility in Architecture and Architectural Education. *In: Archithese: Space and Pedagogy*
- Britton, 1989. The Economic. Efficient and Effective Management of Public Authority Landed Estates. London: School of Surveying, Kingston University.
- Brown, R, Keath, N & Wong, T. 2009. Urban Water Management in Cities: Historical, Current and Future Regimes. *In: Wat. Sci. Technol.* 59 (5).
- Brundtland, G, et al, and World Commission on Environment and Development. 1987. *Our Common Future*, New York: Oxford University Press.
- Cary, PAJ. 2011. *The Power of Pro Bono: 40 Stories about Design for the Public Good by Architects and Their Clients*. Distributed Art Publishers.
- Christiaanse, K. 2000. *Situation: KCAP Architects and Planners*. Birkhauser Verlag AG.
- Christiaanse, K. 2009. Curating the Open City. Interview: Kees Christiaanse. Places: DesignObserver [online]. Available from: <http://places.designobserver.com/feature/curating-theopen-city/10887/> (Accessed on 12 January 2015)
- Census of Population and Housing, 2010. Philippine National Statistics Office. Report Number 2A.
- Constantino-David, K. 2002. Unsustainable development: the Philippine experience.
- Westendorff, D and Eade, D. 2002. *Development and Cities: Essays from Development and Practice*, pp. 122-135. Oxfam GB.
- Corner, J and MacLean, A. 1996. *Taking Measures Across the American Landscape*. New Haven, CT: Yale University Press.

Corner, J 1997. Ecology and Landscape as Agents of Creativity. Thompson, G and Steiner, F. eds. *Ecological Design and Planning*. New York: Wiley.

Corner, J. 1999. Eidetic Operations and New Landscapes. Corner, J. ed. *Recovering Landscape: Essays in Contemporary Landscape Architecture*. New York: Princeton Architectural Press, p. 152-169.

Corner, J. 1999. Landscape and ecology as agents of creativity. In: Thompson, G.F. and Steiner, R.F. eds. *Ecological Design and Planning*. John Wiley & Sons, Inc., New York, pp. 80–108.

Corner, J. 1999. The Agency of Mapping: Speculation, Critique and Invention. Cosgrove, D. ed. *Mappings*. London: Reaktion Books, pp 213-300.

Corner 2003. In Mostafavi, M and Najle C. eds. 2003. *Landscape Urbanism*, London: Architectural Association.

Corner, J. 2006. Terra Fluxus. Waldheim, C., 2006. *The Landscape Urbanism Reader*, 01 edition. ed. Princeton Architectural Press, New York.

Corner, J. 2014. *The Landscape Imagination*. New York: Princeton Architectural Press,

Crichton, D 1999 The risk triangle. In: Ingleton, J. ed. 1999, *Natural Disaster Management* (pp. 102–103). Leicester: Tudor Rose.

De Baan ed. 2007. *Visionary power: producing the contemporary city / International Architecture Biennale Rotterdam*. Rotterdam: NAI Publishers.

de Certeau, M. 1984. *The Practice of Everyday Life*. Berkeley, CA: University of California Press.

Dehs, MWE and Pedersen Jørgen, CP. 2013. *When Architects and Designers Write, Draw, Build*. Aarhus: Förlag.

Djordjevic, S. 2013. *Final Report on Collaborative Research on Resilience in Urban Areas (CORFU)*. Available at:  
:http://www.corfu7.eu/media/universityofexeter/research/microsites/corfu/1publicdocs/publicresults/CORFU\_Project\_Final\_Report.pdf [Accessed 24 May 2014]

Dreiseitl, H. 2009. *Recent Waterscapes: Planning, Building and Designing with Water*. Revised and expanded ed. edition. ed. Basel: Birkhäuser .

Duffy, A 2009. *Summary Report: Benchmarking Assessment of SWITCH Program Partner Cities*. Reported to The Global City Water Futures Summit, 7th to 10th October 2009, Delft, The Netherlands, on behalf of UNESCO-IHE SWITCH – Managing Water for the City of the Future Program, unpublished.

El-Khoury, R, Robbins, E eds. 2013. *Shaping the city: studies in history, theory and urban design*. London: Routledge.



EMBT, 2010. Hafencity Public Space by Miralles Tagliabue | Parks. Available from: <https://www.architonic.com/en/project/miralles-tagliabue-hafencity-public-space/5100909> (accessed 15.07.14).

Environment Agency and CIRIA. 2001. *Damage limitation: How to Make Your Home Flood Resistant*. Bristol: Environment Agency.

Environment Agency. 2009. *Thames Estuary 2100: Managing Flood Risk through London and the Thames Estuary. TE2100 Plan Consultation Document*. London: Environment Agency.

European Environment Agency. 2013. *Adaptation in Europe - Addressing risks and opportunities from climate change in the context of socio-economic developments*. Environment Agency. Report Number 3.

Evans, V, Bark, R & Paavola, J. 2004. Flood risk perceptions and the UK media: Moving beyond "once in a lifetime" to "Be Prepared" reporting. *Climate Risk Management* 17, 1–10.

Faisal, I, Kabir, M and Nishat, A. 1999. Non-structural flood mitigation measures for Dhaka City. *Urban Water*, 1: 145–153.

Feyen, J, Shannon, K, Neville, M. eds. 2008. *Water and Urban Development Paradigms: Towards an Integration of Engineering, Design and Management Approaches*. 1 edition. ed. Boca Raton, Fla: CRC Press,

Fletcher, T. et al. 2014. SUDS, LID, BMPs, WSUD and more: The evolution and application of terminology surrounding urban drainage. *In: Urban Water J.* doi:10.1080/1573062X.2014.916314.

Fraser, M. 2013. *Design Research in Architecture: An Overview*, 1 edition. ed. Burlington: Routledge.

Frayling, C. 1993. *Research in art and design*. Research Paper. London: Royal College of Art

Gadanhó, P and Lowry, GD. 2014. *Uneven Growth: Tactical Urbanisms for Expanding Megacities*, 01 edition. New York, New York: ed. The Museum of Modern Art,

Gandy, M. 2015. From urban ecology to ecological urbanism: an ambiguous trajectory. *Area* 47, pp. 150–154.

Gans, D. 2011. Below the Will Plate. In: Aquilino, M, 2011. *Beyond shelter: architecture for crisis*. London: Thames & Hudson.

Geddes, P. 1915. *Cities in Evolution*, rev. ed. (1949), London: Williams and Norgate.

Geels, F. 2004. From sectoral systems of innovation to socio-technical systems. Insights about dynamics and change from sociology and institutional theory. *Research Policy*, 33: 897–920.

Gehl, J. 2011. *Life Between Buildings: Using Public Space*, 6 edition. ed. Washington, DC.: Island Press.

Gill, D and Bonnett, P. 1973. *Nature in the Urban Landscape: A Study of Urban Ecosystems*, Baltimore: York Press.

Godfrey et al., 2012, *Future Proofing Cities Report*. London: Atkins

Groat, LN and Wang, D. 2013. *Architectural Research Methods*, Second Edition, 2nd ed. edition. ed. J Amsterdam ; Boston: John Wiley & Sons.

Guazon, T. 2013. Public Art, urban renewal and the construction of a national history: The Revive Manila Program and the New Manilenño campaign. In Perera, N, Tang, W ed. 2013. *Transforming Asian cities: intellectual impasse, Asianizing space, and emerging translocalities*. London: Routledge.

Guéguen, C. 2010. Moving from Binondo to the “Chinese Villages” of the Suburbs: A Geographical Study of the Chinese in Metro-Manila. *Journal of Chinese Overseas*, Volume 6, Issue 1, p.119-137.

Haas-Arndt, D. 2008. *Basics Water Cycles*. Basel ; Boston: Birkhäuser GmbH.

HafenCity GmbH, n.d. *HafenCity Hamburg – Publications*. Available from: <http://www.hafencity.com/en/publications.html> (accessed 25.03.14).

HafenCity Hamburg GmbH. 2004. Focus on – The Überseequartier: Pulsating Centre on the Elbe River. [online] Available from <http://www.hafencity.com>. [Accessed: 16th February 2014]

HafenCity Hamburg GmbH. 2004. *The Masterplan*. [online] Available from <http://www.hafencity.com>. [Accessed: 16th February 2014]

HafenCity Hamburg GmbH. 2004. Projects – Insights in the Current Developments. [online] Available from <http://www.hafencity.com>. [Accessed: 16th February 2014]

HafenCity Hamburg GmbH. 2009. *The birth of a city : Hafencity Hamburg*. Hamburg: HafenCity Hamburg

Hagan, S., 2015. *Ecological Urbanism: The Nature of the City*, 1 edition. ed. New York, NY: Routledge.

Hamburg Port Authority. 2006. *Focus of Dynamic Growth Markets, Free and Hanseatic City of Hamburg*. [online] Available from <http://www.hamburg-port-authority.de> [Accessed: 19th February 2014]

Hamburg Port Authority. 2013. *TIDE: Tidal River Development - Joint study on mitigation measures in the estuary mouth (Scheldt & Elbe)*

Hanson, S and Nicholls, R. 2011. Planning for Changes in Extreme Events in Port Cities throughout the 21st Century. In: Aerts, J. 2011. *Climate adaptation and flood risk in coastal cities*. London: Routledge.

- Hawley, C. 2012 *Urban Collage*. Bartlett Design Research Folios. London: University College London.
- Hawley, C. 2013. *Transitions: Concepts + Drawings + Buildings*, 1 edition. ed. Burlington, VT: Routledge.
- Heynen, N, Kaika, M, Swyngedouw, E, 2006. *In the Nature of Cities: Urban Political Ecology and the Politics of Urban Metabolism*. Routledge.
- Hill, K. 2007. Urban Ecological Design and Urban Ecology: An Assessment of the State of Current Knowledge and a Suggested Research Agenda. Novotny, V and Brown, P. eds. 2007. *Cities of the Future: Towards Integrated Sustainable Water and Landscape Management*. London: IWA Publishing, pp 251-266.
- Hill, K. 2011. Climate-Resilient Urban Waterfronts. Aerts, J. 2011. *Climate adaptation and flood risk in coastal cities*. London: Routeledge.
- Hodal, 2013. Manila is a Hotbed of Progressive Housing Solutions. *Next City*. Available from: <https://nextcity.org/features/view/slum-lab-manilas-quest-to-build-a-better-informal-settlement> (accessed 5.07.17).
- Hooimeijer, F, Meyer, H, Nienhuis, A, 2005. *Atlas of Dutch Water Cities*, Amsterdam: Sun Publishers.
- Howe, C and Mitchell, C. eds. 2011. *Water Sensitive Cities* (Cities of the Future Series). IWA Publishing. London.
- Huq, S and Alam, M. 2003. Flood Management and Vulnerability of Dhaka City. Dhaka: Bangladesh Center of Advance Studies (BCAS).
- International Panel on Climate Change (IPCC). 2007. *Climate Change 2007: Synthesis Report. Contribution of Working Groups I, II, III to the Fourth Assessment Report of the Intergovernmental Panel on Climate Change*, Geneva: IPCC.
- Izembart, H, Boudec, BL. 2003. *Waterscapes: Using Plant Systems to Treat Wastewater*. Barcelona: Gustavo Gili.
- Jabeen, H, Johnson, C, Allen, A, 2010. Built-in resilience: Learning from grassroots coping strategies for climate variability. *In: Environment and Urbanization* 22, 415-431. <https://doi.org/10.1177/0956247810379937>
- Jia, S. 2013. *Water Landscapes*. Hong Kong: Artpower International,
- Johnson, C. ed. 2011. *The neoliberal deluge : Hurricane Katrina, late capitalism, and the remaking of New Orleans*. London: University of Minnesota Press.
- Joost, G, Bredies, K, Christensen, M, Conradi, F, Unteidig, A. eds. 2016. *Design as Research: Positions, Arguments, Perspectives*. Basel: Birkhauser.
- Karvonen, A. 2011. *Politics of Urban Runoff: Nature, Technology, and the Sustainable City (Urban and Industrial Environments)*. MIT Press.

*Katrina, The New Orleans Nightmare : Documentary on the Devastation of Hurricane Katrina.*  
n.d. [Film] Directed by: Armanafa, A.

Kendrick, M 1988. The Thames barrier. *In: Landscape and Urban Planning*, 16(1-2), 57–68.

Koolhaas, R.1995. Atlanta. *In: Koolhaas, R.1995. S,M, L, XL.* New York: Monacelli, 835.

Kowaleski, M. 2011. Visual Discourse of HafenCity in Hamburg. Preliminary Results of the Research Project, *Roczniki Socjologii Morskiej*, Issue XX.

Kuhlicke, C, & Steinführer, A. 2010. *Social capacity building for natural hazards.* (CapHaz-Net WP1 Report). [online] Available from: <http://caphaz-net.org/outcomes-results>

Lateral Office. 2010. *In: White, M., Bhatia, N., Sheppard, L., Przybylski, M., 2010. Pamphlet Architecture 30: Coupling: Strategies for Infrastructural Opportunism*, 01 edition. ed. Princeton Architectural Press, New York.

Laurie, I. ed. 1979. *Nature in Cities*, Chichester, England: Wiley.

Lawson B. 1994. *Design in Mind*. Oxford: Butterworth Architecture.

Lawson, B. 1997. *How Designers Think: The Design Process Demystified*, 3rd edition. ed. Amsterdam:Routledge,

Lawson, B. 2004. *What designers know*. Boston, MA: Architectural Press.

Lefebvre, H. 1996. The right to the city. Kofman, E & Lebas, E. eds. *Henri Lefebvre: Writing on Cities*. Oxford: Blackwell. pp 147-159.

Lefebvre, H. 1996. *Writings on cities*. Malden, MA, USA: Blackwell Publishing.

Lerner, J. 2016. *Urban Acupuncture*. Reprint edition. ed. I Washington: Island Press.

Lico, G.,2010. *Arkitekturang Filipino: A History of Architecture and Urbanism in the Philippines*. Quezon City: University of Hawai'i Press, Diliman.

Lim, CJ, Liu, E. eds. 2010. *Smartcities and Eco-Warriors*. Routledge. New York. Abingdon England ;

Lister, M. 2010. Adapt: Insurgent ecologies: (re)claiming ground in landscape and urbanism. *In: Mostafavi M and Doherty G. eds. 2010. Ecological urbanism*. Basel: Lars Müller.

Lloyd Jones, T. 2013. *Urban Resilience, Addressing Risk in Rapidly Growing Cities in the Developing World*. [Video] Available from: <https://www.youtube.com/watch?v=mh-2uCZg9Ws> [accessed 5.11.2013]

Loe, K. 1999. The Value of Architecture – Context and Current Thinking. RIBA Future Studies Series. London: RIBA.



- Loh, K, Pante, M. 2015. Controlling Nature, Disciplining Human Nature: Floods in Singapore and Metro Manila, 1945-1980s. *In: Nature + Culture 10*, 36–56. <https://doi.org/10.3167/nc.2015.100103>
- Lusterio, A 2011. Sustainable Communities: Avoiding Disaster in the Informal City. In Aquilino, M, 2011. *Beyond shelter: architecture for crisis*. London: Thames & Hudson.
- Lynch, K. 1960. *The image of the city*. Publication of the Joint Center for Urban Studies. Cambridge, Mass: MIT Press.
- Lyndon, M and Garcia, A, 2015. *Tactical Urbanism*. Washington, DC: Island Press.
- Malcañan Palace | Presidential Museum & Library, 2015. The Evolution of Manila. Presidential Museum and Library. Available from: <http://malacanang.gov.ph/75830-the-evolution-of-manila/> (accessed 24.09.14).
- Manila, City of. 2006. The Comprehensive Development Plan of the City of Manila 2006.
- Manila Burnham Plan. 1905. *Manila Burnham Plan: Plan of Proposed Improvements*. New York: Avery Architectural and Fine Arts Library, Columbia University.
- Maplecroft, 2013. Maplecroft's Climate Change and Environmental Risk Atlas 2013. Available from: [https://www.maplecroft.com/about/news/ccvi\\_2013.html](https://www.maplecroft.com/about/news/ccvi_2013.html) (accessed 8.11.13).
- Mayne, T. 2011. *Combinatory Urbanism: A Realignment of Complex Behavior and Collective Form*. Stray Dog Cafe
- McDonald, R. 2003. *Introduction to Natural and Man-made Disasters and Their Effects on Buildings: Recovery and Prevention*, 1 edition. ed. Amsterdam: Routledge,
- McHarg, I. 1995. *Design With Nature (Wiley Series in Sustainable Design)*. John Wiley & Sons.
- McHarg, I.L. 2006. The Essential Ian McHarg: Writings on Design and Nature. Island Press.
- Michel, B. 2010. *Global City als Projekt: Neoliberale Urbanisierung und Politiken der Exklusion in Metro Manila*. Bielefeld: Transcript Verlag.
- Miller, DS. 2009. *Hurricane Katrina and the Redefinition of Landscape*. Maryland: Lexington Books.
- Moore, C. 1968. *Daniel H. Burnham; architect, planner of cities*. Da Capo Press.
- Mostafavi, M and Najle C. eds. 2003. *Landscape Urbanism*, London: Architectural Association.
- Mostafavi M. 2010. Why ecological urbanism? Why now? Mostafavi M and Doherty G. eds. 2010. *Ecological urbanism*. Basel: Lars Müller. pp: 12–55
- Mostafavi M and Doherty G. eds. 2010. *Ecological urbanism*. Basel: Lars Müller.

Navarro-Sertich, A, Brillembourg, A. 2011. From product to process: Building on Urban-Think Tank's approach to the informal city. *In: Architectural Design* 81, 104–109.

Nemes, J. n.d. *Dutch Dialogues: New Orleans architects look to the Netherlands for ideas on living with water*. Available from: <http://plus.usgbc.org/dutch-dialogues/> [accessed 15.12.13]

Netherlands Water Management Policy 2000. Commissie Waterbeheer, van Buuren, M, van Rooij, S. 2004. *Flood-risk Management Strategies for an Uncertain Future: Living with Rhine River Floods in The Netherlands?* AMBIO: A Journal of the Human Environment 33, 141–147.

Nicholls, R et al. 2008. *Ranking Port Cities with High Exposure and Vulnerability to Climate Extremes: Exposure Estimates*. Environment Working Papers No. 1. Paris: Organization for Economic Co-Operation and Development.

Nillesen, AL. 2011. *Amphibious Housing in The Netherlands. Architecture and Urbanism on the Water*, Bilingual edition. ed. Rotterdam: NAI Publishers,

NOLA, 2013. *Federal judge blasts Army Corps of Engineers for failing to protect New Orleanians during Katrina* [online]. Available from: [http://www.nola.com/environment/index.ssf/2013/04/federal\\_judge\\_blasts\\_army\\_corp.html](http://www.nola.com/environment/index.ssf/2013/04/federal_judge_blasts_army_corp.html) [accessed 13.02.14].

OECD, 2015. *Adapting to the impacts of climate change*. Paris: OECD Publishing Available from: <https://www.oecd.org/env/cc/Adapting-to-the-impacts-of-climate-change-2015-Policy-Perspectives-27.10.15%20WEB.pdf>

Olthuis, K and Keuning, D. 2010. *Float!: Building on Water to Combat Urban Congestion and Climate Change*, 01 edition. ed. F Amsterdam : Minneapolis: Frame Publishers.

Olthuis, K., 2013. Thalassophilanthropy: APP-Grading Wet Slums. Floating urban components to address rising water challenges threatening communities in need.

Olthuis, K. 2014 Waterstudio - Floating City Apps. Available from: <https://www.floatingcityapps.com> [Accessed 15.07.15]

OMA Rebuild by Design. <http://oma.eu/projects/resist-delay-store-discharge-comprehensive-urban-water-strategy>

Organisation for Economic Co-operation and Development (OECD). 1994. *Cities for the 21st Century*, Paris: Organization for Economic Co-operation and Development.

Organisation for Economic Co-operation and Development (OECD). Kamal-Chaoui, L and Robert, A. eds. 2009. *Competitive Cities and Climate Change*. [online] Available from <http://www.oecd.org/gov/regional/workingpapers>.

Ovink, H. 20.12.2017. How to Think Like the Dutch in a Post-Sandy World. *The New York Times*. Available from: <https://www.nytimes.com/2014/04/13/magazine/how-to-think-like-the-dutch-in-a-post-sandy-world.html>. [Accessed 27.12.2016]

Pante, MD. 2016. The Politics of Flood Control and the Making of Metro Manila. *Philippine Studies: Historical and Ethnographic Viewpoints* 64, pp. 555–592. Available from: <https://doi.org/10.1353/phs.2016.0040>

Pasdzior, M. and Engel, D. 2013. *Speicherstadt und Hafencity*. Erfurt: Sutton Verlag GmbH.

Perera, NT. Ed. 2013. *The Transforming Asian Cities*. London ; New York.

Philippine Statistics Authority. 2015. Population Projection Statistics | Philippine Statistics Authority [online]. Available from: <https://psa.gov.ph/statistics/census/projected-population> (accessed 15.02.15).

Pollak, L. 2006 In Waldheim, C., 2006. *The Landscape Urbanism Reader*, 01 edition. ed. Princeton Architectural Press, New York.

Prominski, M, Stokman, A, Stimberg, D, Voermanek, H, Zeller, S. eds. 2012. *River. Space. Design: Planning Strategies, Methods and Projects for Urban Rivers*. Basel: Birkhauser Verlag A.

Prosun, P. 2011. The LIFT House: An amphibious strategy for sustainable and affordable housing for the urban poor in flood-prone Bangladesh.

Reardon, K, Forester, J, 2015. *Rebuilding Community After Katrina: Transformative Education in the New Orleans Planning Initiative*. Temple University Press.

Recio, R. 2013. Lungsod Iskwat: the evolution of informality as a dominant pattern in Philippine cities. In: *Philippine Political Science Journal* 34, 221–223. <https://doi.org/10.1080/01154451.2013.851497>

Reed, C. 2011. The Agency of Ecology. Mostafavi, M and Doherty, G. eds. 2010. *Ecological Urbanism*, Baden, Switzerland: Lars Müller.

Rijke, J., Van Herk, S., Zevenbergen, C., Ashley, R., 2012. *Room for the River: Delivering integrated river basin management in the Netherlands*. *International Journal of River Basin Management* 10, 1–21.

Robas, R. 2014. Flood Disaster Risk Reducation and Risk Management of Pasig City. Thesis. Manila: De La Salle University.

Robbins, E. 1997. *Why Architects Draw*. Cambridge, Mass.: MIT Press.

Romero, P. 2013. Manila – The Informal City Dialogues [online]. Available from: <https://nextcity.org/informalcity/city/manila> (accessed 24.11.17).

- Rosa, ML. 2013. *Handmade Urbanism: Mumbai - Sao Paulo - Istanbul - Mexico City - Cape Town: From Community Initiatives to Participatory Models*, Berlin: JOVIS Verlag.
- Royal Institute of British Architects (RIBA). 2007. *Designing for Floodrisk / Flood / Emergency Management* [WWW Document]
- Ryan, Z. 2010. *Building with Water: Concepts / Typology / Design*. Basel: Birkhäuser GmbH.
- Schueller, N, Wollenburg, P and Christiaane, K. 2012. *Urban Reports: Amsterdam, Bilbao, Copenhagen, Dublin, Zagreb, Zurich: Urban strategies and visions in mid-sized cities in a local and global context*. Zürich: gta Verlag.
- Sepe, M ed. 2013. *Planning and place in the city: mapping place identity*. London: Routledge.
- Shannon, K. 2013. Water: Asia's New Battleground. *In: Journal of Landscape Architecture* 8:2, pp. 87-88.
- Shannon, K & De Meulder, B. 2014. *Water Urbanisms - East*, Park Books. UFO: Explorations of Urbanism
- Shatkin, G. 2004. Planning to forget: Informal settlements as 'forgotten places' in globalising Metro Manila. *In: Urban Studies* 41(12): pp. 24-69.
- Shatkin, G. 2005. Colonial capital, modernist capital, global capital: The changing political symbolism of urban space in Metro Manila, the Philippines. *In: Pacific Affairs* 78, 577-600.
- Shatkin, G. 2016. *Collective Action and Urban Poverty Alleviation: Community Organizations and the Struggle for Shelter in Manila*. 1 edition. ed. Routledge.
- Shaw, R. and IEDM Team. 2009. *Climate Disaster Resilience: Focus on Coastal Urban Cities in Asia*. [online] Available from: URL: [http://www.unescap.org/idd/events/2009\\_EGM-DRR/Japan-Rajib-Shaw-CLIMATE-DISASTER-RESILIENCE.pdf](http://www.unescap.org/idd/events/2009_EGM-DRR/Japan-Rajib-Shaw-CLIMATE-DISASTER-RESILIENCE.pdf)
- Singson, R. 2013. Metro Manila Integrated Flood Risk Management Master Plan. [online]. Available from: [http://www.gfdrr.org/sites/gfdrr.org/files/\(SESSIO%203\)Sec.Singson\(Philippines\)052413DPW HFLOODRISKMANAGEMENT\(SECRETARY\).pdf](http://www.gfdrr.org/sites/gfdrr.org/files/(SESSIO%203)Sec.Singson(Philippines)052413DPW HFLOODRISKMANAGEMENT(SECRETARY).pdf)
- Sinclair, C. ed.. 2006. *Design Like You Give a Damn: Architectural Responses to Humanitarian Crises*. New York, NY: Metropolis Books.
- Sklar, L. 1992. Technical review of the Bangladesh Flood Action Plan. IRN working paper ; 1. Bhuapur Development Project, Service Civil International, Bhuapur, Bangladesh
- Solà-Morales, M. 2008. *A Matter of Things*. Rotterdam: NAI Publishers.
- Spits, J, Needham, B et al. 2010. Reframing floods: Consequences for urban riverfront developments in Northwest Europe. *In: Nature and Culture*, vol 5, no 1
- Stalenberg, B. 2011. Innovative Flood Defences in Highly Urbanised Water Cities. *In: Aerts, J. 2011. Climate adaptation and flood risk in coastal cities*. London: Routledge.



Stern, N. 2006. *The Economics of Climate Change: The Stern Review*, Cambridge: Cambridge University Press

Spirn, A. W. 2000. Reclaiming Common Ground: Water, Neighborhoods, and Public Space. In: Fishman, F. ed., *The American Planning Tradition: Culture and Policy*. Baltimore, MD: Johns Hopkins University Press.

Spirn, A. 2008. One with Nature: Landscape, Language, Empathy, and Imagination. In: DeLue, R. and Elkins, J. eds. *Landscape Theory*. New York: Routledge.

Spirn, AW. 2014. Ecological Urbanism: A Framework for the Design of Resilient Cities (2014), in: *The Ecological Design and Planning Reader*. Washington, DC: Island Press , pp. 557–571. [https://doi.org/10.5822/978-1-61091-491-8\\_50](https://doi.org/10.5822/978-1-61091-491-8_50)

Steenbergen, C. Zwart, J. van der, Grootens, J., 2009. *New Dutch Water Defence Line*, 01 edition. ed. Uitgeverij, Rotterdam: 010 .

Sudjic, D. 2017. *The Language of Cities*. Penguin.

Till, J. 2007. *What is architectural research? Architectural Research: Three Myths and One Model*. RIBA R&D Department

Thackara, J., 2017. *How to Thrive in the Next Economy: Designing Tomorrow's World Today*, Reprint edition. ed. Thames and Hudson Ltd.

Thompson, G and Steiner F. eds. 1997. *Ecological Design and Planning*. New York: Wiley.

Tol, R, Klein, R and Nicholls, R. 2008. Towards successful adaptation to sea level rise along Europe's coasts. In: *Journal of Coastal Research*, vol 24, no 2.

Tomeldan, M., n.d. The Special Precincts for Urban Redevelopment (SPURs) of Makati City, Metro Manila, Philippines | Joana Dungca and Dylan Melgazo. Available from: [https://www.academia.edu/19858884/The\\_Special\\_Precincts\\_for\\_Urban\\_Redevelopment\\_SPURs\\_of\\_Makati\\_City\\_Metro\\_Manila\\_Philippines](https://www.academia.edu/19858884/The_Special_Precincts_for_Urban_Redevelopment_SPURs_of_Makati_City_Metro_Manila_Philippines) [accessed 28.06.17].

Tschumi, B. 1985. La Villette Competition Entry. "The La Villette Competition" *Princeton Journal* vol.2 "On Landscape".

Tschumi, B. 1987. *Cinegramme Folie: le Parc de la Villette*. Princeton University Press, Princeton, NJ.

Tufte, E. 1990. *Envisioning information*. Cheshire, Conn: Graphics Press.

United Nations Economic and Social Commission Organisation (UNESCO). 2006. *Tourism, Culture and Sustainable Development*. Paris: Unesco Publishing.

United Nations Economic and Social Commission for Asia and the Pacific. 1999. *Regional Cooperation in the Twenty-First Century on Flood Control and Management in Asia and the Pacific*. United Nations: New York.

United Nations Office for Disaster Risk Reduction (UNISDR). 2005. *Disaster risk reduction*

*tools and methods for climate change adaptation*. Inter-Agency Task Force on Climate Change and Disaster.

Vale, L J and Campanella, T J. eds. 2005. *The Resilient City: How Modern Cities Recover from Disaster*. New York: Oxford.

Urban Think Tank. 2010 'Southern Exposures: Towards a Social Responsibility in Architecture and Architectural Education.' *Archithese: Space and Pedagogy*.

Urban Think Tank, 2013. Torre David. DisegnoDaily. Available from: <https://www.disegnodaily.com/article/torre-david> (accessed 24.08.17).

Valmero, A., 2012. Cleaning Up Manila's Pasig River, One Tributary at a Time *CityLab*. Available from: <http://www.citylab.com/weather/2016/06/cleaning-up-manilas-pasig-river-one-tributary-at-a-time/488885/> (accessed 21.08.16).

Vigano, P, Secchi, B, Fabian, L, 2016. Water and Asphalt: *The Project of Isotropy in the Metropolitan Area of Venice*. Zürich: University of Chicago Press.

Von Einsiedel, N. 1992. Future directions of urban planning in the Philippines. *In: Habitat International* 16, 167–180.

Waldheim, C., 2006. *The Landscape Urbanism Reader*, 01 edition. ed. Princeton Architectural Press, New York.

Waldheim, C. 2010. Weak work: Andrea Branzi's 'Weak metropolis' and the projective potential of an 'ecological urbanism. Mostafavi M and Doherty G. eds. 2010. *Ecological Urbanism* Lars Müller, Basel pp. 114–21.

Wall, A. 1999. "Programming the Urban Surface," 234–249. In Corner, J. ed. 1999. *Recovering Landscape, Essays in Contemporary Landscape Architecture*. New York: Princeton Architectural Press. 233–249.

Warren, J. 2013. A Tale of Two Decades: Typhoons and Floods, Manila and the Provinces, and the Marcos Years | *The Asia-Pacific Journal: Japan Focus*, 11 (43), No. 3.

Watson, D. Adams, M. 2010. *Design for Flooding: Architecture, Landscape, and Urban Design for Resilience to Climate Change*. 1 edition. ed. Hoboken, N.J.: John Wiley & Sons,

Whiston, A. 2008. "One with Nature": Landscape, Language, Empathy, and Imagination," in R. DeLue and J. Elkins, eds., *Landscape Theory*, New York: Routledge.

White, I. 2010. *Water and the City: Risk, Resilience and Planning for a Sustainable Future*, 1 edition. ed. Routledge, New York.

White, M., Bhatia, N., Sheppard, L., Przybylski, M., 2010. *Pamphlet Architecture 30: Coupling: Strategies for Infrastructural Opportunism*, 01 edition. ed. New York: Princeton Architectural Press,

Wong, T, Brown, R. 2014. Integrated urban water planning realising water sensitive cities.

World Bank. 2008. *Climate Resilient Cities. A Primer on Reducing Vulnerabilities to Climate Change Impact and Strengthening Disaster Risk Management in East Asian Cities*. Washington.

World Bank, 2012. *Cities and Flooding: A Guide to Integrated Urban Flood Risk Management for the 21st Century*. Washington, D.C.: World Bank Publications.

World Economic Forum. 2016, The Global Risks Report 2016. Geneva: World Economic Forum Publishing. Available from: <https://www.weforum.org/reports/the-global-risks-report-2016/>

World Resources Institute, 2015. *Why Cities Need to Address River Flooding Now* | World Resources Institute [online]. Available from: <http://www.wri.org/blog/2015/03/why-cities-need-address-river-flooding-now> (accessed 5.12.13).

Yeang, K. 2009. *Ecomasterplanning: The Work of Ken Yeang*, 1 edition. ed. Chichester. West Sussex: John Wiley & Sons,

Zoleta-Nantes, D. 2000. Flood Landscapes of Metro Manila. In: L. Liongson, G. Tabios and Castro P. eds. *Pressure of Urbanization: Flood Control and Drainage in Metro Manila*. UPCIDS Diliman.

Zoleta-Nantes, Doracie B. 2000. *Flood Hazards in Metro Manila: Recognizing Commonalities, Differences, and Courses of Action*. Diliman: Social Science 1(1): pp. 60–105.

Zoleta-Nantes, D. 2000. Flood Landscapes of Metro Manila. *Pressures of Urbanization: Flood Control and Drainage in Metro Manila*. Leonardo Q, Liongson, Guillermo Q, Tabios III, and Peter P. M. Castro, eds. pp. 35–51. Quezon City: University of the Philippines Press.

Zoleta-Nantes, DB. 2002. Differential Impacts of Flood Hazards Among the Street Children, the Urban Poor and Residents of Wealthy Neighborhoods in Metro Manila, Philippines. *Mitigation and Adaptation Strategies for Global Change* 7, pp. 239–266.

Zwart, CSJ. van der. 2010. *Atlas Of The New Dutch Water Defence Line*. Rotterdam: 010 Publishers.

**Interviews:**

## Manila:

- Palafox, F. (2014, August 08). Personal interview.
- Alcazaren, P. (2014, August 07). Personal interview.
- Galicia, D. (2015, August 06). Personal interview.
- Yupangco, J. (2014, July 19). Personal interview.
- Rubio, M. (2014, Aug 07). Personal interview.
- Singson, D. (2014, July 22). Personal interview.
- Tolentino, F. (2014, July 22). Personal interview.
- So, R. (2015, October 08). Personal interview.
- Holland, R. (2014 July 23). Personal interview.

## London:

- Bell, S. (2016, March 07). Personal interview.
- Parikh, P. (2016, February 24). Personal interview.
- Gattarell, M. (2016, April 29). Personal interview.
- Hawley, C. (2016, May 16). Personal interview.
- Wharton, G. (2016, March 21). Personal interview.
- Ovink, H. (2016, February 16). Personal interview.
- Bishop, P. (2016, February 23). Personal interview.
- Johnson, C. (2014, June 09). Personal interview.